

The AMSAT[®] Journal

Volume 36, Number 3

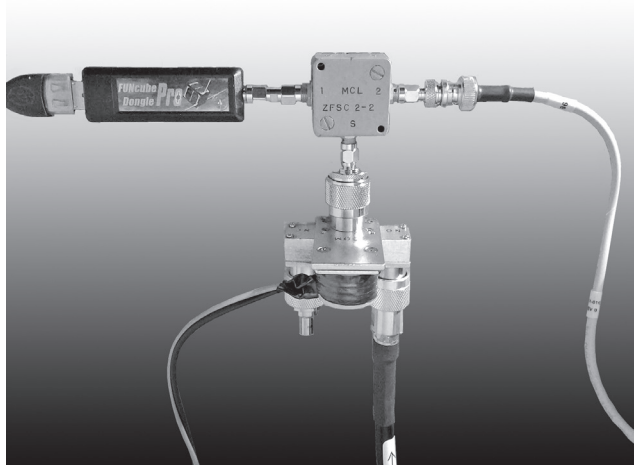
May/June 2013

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AMSAT Fox-1 Has a Launch Date!



FUNcube Dongle Pro+ Advanced Receiver Application

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How You Can Help Build New and Exciting Satellites

Donate to the President's Club

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US taxpayers may be able to receive a significant income tax deduction by making The Radio Amateur Satellite Corporation the owner and beneficiary of life insurance policies.

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US taxpayers should be able to avoid capital gains taxes on appreciated securities and receive a deduction for their fair market value.

Bequest

A codicil in your will, naming The Radio Amateur Satellite Corporation as a beneficiary will help insure the continuance of the Amateur Radio Satellite program.

Call the AMSAT-NA office at 301-589-6062 for questions on any or all of these ways you can help build new and exciting satellites.

Support AMSAT-NA

AMSAT Announcements

2013 AMSAT Space Symposium and Annual General Meeting Announcement

The 2013 AMSAT Space Symposium and Annual General Meeting will be held November 1-3 in Houston, Texas at the Marriott Hobby Airport Hotel.

The Board of Directors will meet at the hotel on October 31- November 1, 2013. This meeting is open for all interested members.

For additional information refer to the Symposium advertisement on page 24. Details will be published on the web and AMSAT News Service Bulletins.

Call for Papers

This is the first call for papers for the 2013 AMSAT Annual Meeting and Space Symposium. Proposals for papers, symposium presentations and poster presentations are invited on any topic of interest to the amateur satellite community. We request a tentative title of your presentation as soon as possible, with final copy to be submitted by October 1, 2013 for inclusion in the printed proceedings. Abstracts and papers should be sent to Dan Schultz at n8fgv@amsat.org

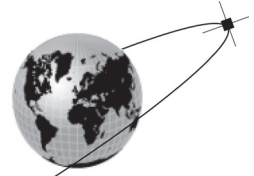
AMSAT's Mission

AMSAT is a non-profit volunteer organization which designs, builds and operates experimental satellites and promotes space education. We work in partnership with government, industry, educational institutions and fellow Amateur Radio societies. We encourage technical and scientific innovation, and promote the training and development of skilled satellite and ground system designers and operators.

AMSAT's Vision

Our Vision is to deploy satellite systems with the goal of providing wide-area and continuous coverage. AMSAT will continue active participation in human space missions and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups.





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I'm writing this column only a few days before Hamvention (May 17-20), so some of what I discuss below will also be covered at the AMSAT Forum at Hamvention. I trust that my presentation at Hamvention will convey the enthusiasm and significant accomplishments of this organization. Indeed, our Hamvention theme this year is "AMSAT - A View to the Future" which reflects not only a forward thinking organization but also one that has the talent to make things happen.

The Fox-1 Design

Certainly one area where AMSAT is creating an exciting vision is the design and construction of our Fox-1 cubesat. This new spacecraft is configured to support scientific payloads through an innovative low speed data and telemetry capability that allows amateur radio FM voice communications to take place at the same time that spacecraft telemetry and payload data is sent to the ground. If the payload requires higher capacity data downlink capability, the spacecraft will also support a 9600-baud downlink, but such operation precludes simultaneous voice operation. The spacecraft also features a robust RF system that overcomes issues that other cubesats have suffered in the past with unreliable performance. Once we prove the feasibility of the design with the flight of Fox-1, our vision is to offer the design to other cubesat builders, such as universities as well as offer to partner with scientific payload providers on joint missions. This approach ensures that amateur radio is integral to future missions as well as provides a reliable RF package while the scientific payload provides the justification for flight that would be paid by those interested in supporting the science package.

Another example of looking forward is creating relationships with universities interested in collaborating with AMSAT. I noted in my last column the Virginia Tech Collaboration Agreement that was signed this past February. We're already beginning to see a direct consequence of that agreement as students at Virginia Tech are developing a camera for inclusion in the Fox-1 spacecraft. Imagery from the camera will be sent down to earth with the telemetry and MEMS Gyro data.

I also should note the evolving relationship with Vanderbilt University's Institute for Space and Defense Electronics (ISDE). We previously announced that Fox-1B will incorporate an ISDE payload that is the

basis for our follow-on satellite, which will be known as "RadFxSat." However, we now expect to incorporate a small scientific payload from ISDE into Fox-1 as well, again using the same telemetry channel as noted earlier to download data while the satellite is being used by amateurs for two-way communications. The potential for adding this experiment allows AMSAT to demonstrate the versatility of the Fox-1 design and adds another dimension to the telemetry/data downlink that is part of the spacecraft design.

The Fox-1 design is a potential "game changer" in providing a versatile spacecraft that meets the needs of payloads as well as enhancing amateur radio's presence in space. Relationships with universities develops a cadre of amateur radio operators and future satellite builders. The integration of payloads into amateur radio spacecraft broadens educational opportunities as the downlinked data is available for all to review and evaluate, including students.

Education Outreach

Certainly a major impact that AMSAT is fostering is how amateur radio in space can be used to encourage students in "STEM" (Science, Technology, Engineering and Mathematics) at all levels. Clearly, our efforts with universities are starting to make some impacts, but the K-12 grades we're only beginning to consider. AMSAT VP-Education Outreach Mark Hammond, N8MH has been working with the ARRL Education Manager Debra Johnson, K1DMJ and ARRL Technology Program Coordinator Mark "Spence" Spencer, WA8SME on how we can take advantage of the upcoming Fox-class cubesat missions in the classroom. Mark Spencer, WA8SME has developed some very interesting ideas to take advantage of the fact that the Fox-class spacecraft's built-in MEMS Gyro can provide attitude information that could be used by students to evaluate the spacecraft's "wobble." Mark has also looked at developing ground-based simulator equipment that could be used to demonstrate what the Fox-class satellite is experiencing in orbit. In addition to creating such equipment, there is also a need to develop educational support materials to assist the educators in how to use amateur radio spacecraft as part of their curriculum. The opportunity to partner with the ARRL in

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education outreach has enhanced AMSAT's ability to focus on this area. Educational materials developed now can certainly be adapted to future missions as well. We're also fortunate that "Spence" is such a prolific and enthusiastic developer of low cost technology in support of space communications and education. He is the developer of the wideband VHF/UHF preamp that AMSAT is now offering with proceeds going to support the Fox-1 and Fox-1B projects; his article on the preamp design was published in the NOV/DEC 2012 issue of the *AMSAT Journal*. Spence is the developer of the "Cubesat Simulator" that has been displayed at our booth at Hamvention and elsewhere. He is also the "brains" behind the MAREA concept that will be demonstrated at the ARRL booth at Hamvention.

As AMSAT moves forward on educational outreach, we're looking for volunteers to help us develop materials and create relationships in the educational community. If you're interested in assisting in this effort, please contact Mark Hammond, N8MH (E-mail: n8mh@amsat.org).

Creating an enhanced educational program that takes advantage of amateur radio in space is another mechanism for justifying future launch opportunities. While STEM has been discussed by government and education officials as being an area that is needed to encourage students to develop the skills for a 21st century economy, there are relatively few programs in place that provide both the opportunity and the materials for a successful outcome. AMSAT has traditionally focused on the engineering aspects of educational programs, such as developing the flight hardware and ground station software for a particular spacecraft. What is needed are materials for teachers and students that will help them know how to access these satellites as well as create opportunities for space science in the classroom. Spence's development of a "wobbler" experiment is one example of adapting Fox-class satellites to the classroom. Such an approach creates justification for using amateur radio satellites in the classroom and this in turn creates support for our programs beyond the amateur radio community.

AMSAT Web Presence

Progress is being made to fully re-establish the AMSAT website following our "hacking" incident earlier this year. A basic web page is now up and running thanks to the efforts of team leader Joe Fitzgerald, KM1P plus the efforts of Patrick Stoddard, WD9EWK,

Alan Biddle, WA4SCA and others. There is a priority list of enhancements that they are working on which includes not only enhancing the "look and feel" of the current website, but re-establishing services that were very popular on the old website, such as satellite status reporting, satellite tracking, and enhanced posting capabilities for ANS and Weekly Satellite Reporting. Out of an abundance of caution, we have forgone "quick hacks" in favor of long term security and maintainability.

Coupled with these efforts are other internet-based services that will be undergoing a change. The AMSAT mail services currently reside on systems at UCSD in California. We will be relocating these services to the same hosting location as the AMSAT Store and our website. Given the volume of traffic and the desire over time to introduce new services, this migration will allow AMSAT to better manage these kinds of activities without conflicting with UCSD policies. For example, our AMSAT Store is physically located at a different site than UCSD to avoid conflicting with UCSD restrictions on funding/financial activity. While UCSD has been most gracious in hosting our mail activities, we also realize that we're placing a burden on them as well. Given the relatively low cost of "hosting services" that handle commercial accounts, the transition will eliminate any potential security or hosting issues for UCSD and allow us to provide new services down the road, such as membership-based access. This transition should be completely transparent to users.

IARU Region 1 Proposal for Two Meters

IARU Region-1 proposed back in 2008 to remove the EME-exclusive designation of the bottom 35 KHz section. Since that time, a proposal has been made by the RSGB to designate this spectrum, on non-exclusive basis, for satellite linear (non-FM) downlink for CW/SSB operation for low earth orbiting satellites. SSB would be coordinated on the lower portion of the 144 MHz segment with CW be positioned at the upper end (near 144.035 MHz).

During the IARU Region 1 VHF-UHF-MW Committee C5 in Vienna April 20-21 the proposal was amended to the bottom 25 kHz. With 10 member-societies in favor and 7 abstaining it was agreed that "If the other two regions are also willing to go for 144.000 and 144.025, then IARU R1 will support this proposal."

As the United States is part of IARU

Region-2, AMSAT has been asked by the ARRL (the IARU member society representing the US) for our thoughts about this proposal as it will be presumably be reviewed by IARU Region-2 members at an upcoming meeting. While such an allocation would be helpful to the amateur satellite community, we are aware that such a change may have impacts on others as well as require FCC approval for US-licensed satellites to use this spectrum. Consequently, we intend to make the effort to seek input from others prior to making a recommendation.

If you wish to share your thoughts on this matter, please don't hesitate to contact any BOD member or by sending an e-mail to bod@amsat.org. By the time this issue of the *AMSAT Journal* is distributed, I expect that we will have on the AMSAT website links to various documents pertaining to this matter for your review. ANS-132 released on 11 MAY 13 also has a write-up about this based on AMSAT-UK reporting of the matter and includes the document links associated with the IARU Region-1 meeting that AMSAT-UK has made available.

AMSAT Symposium

The 31st AMSAT Space Symposium and Annual Meeting will take place 1-3 NOV 13 in Houston, TX. The event takes place at the Marriott Hobby Airport Hotel. Room rate is \$94.00/night and includes free breakfasts, 2 per room per day with free WiFi throughout the hotel. There is free airport transportation. To make reservation, call the hotel at 713-943-7979 and mention reservation code "AMSAMSA" or ask for the "AMSAT Block." Registration for the Symposium will be setup via the AMSAT Store later this summer. Details will be included in the annual mailing that goes to the AMSAT membership in July when ballots for the BOD election are mailed.

Details are still be worked out on potential tour opportunities in the Houston area; stay tuned for future developments.

The AMSAT Board of Directors meeting will take place Thursday, 31 OCT and Friday morning, 1 NOV prior to start of the Symposium itself on Friday afternoon.

We expect this year's Symposium to feature some excellent technical presentations. If you haven't been to a prior Symposium, then please take the time to review the 2012 Proceedings papers that were included in the DVD that you received earlier this year.

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Maurice-André Vigneault, VE3VIG
AMSAT Canada Delegate - ARISS International Working Group
ARISS School Selection Committee

How do we recruit new astronauts? Very early.

Chris Hadfield, at 9 years old, got bitten while watching the Moon landing. Cédric Coté from Montréal, 10 years, got the bug lately when visiting the Museum of Science in Ottawa.

Read the following interview where Cédric explains how he initiated and accomplished an ARISS "Chat with an astronaut" contact.

Interviewer: "How did you organize to talk with an astronaut?"

Cédric: "I went to the Museum of Science and Technology in Ottawa where there was an Amateur Radio operator, Maurice-André Vigneault, who introduced me to Amateur Radio. I liked that very much. At the end, he mentioned that there was a program to talk to astronauts on the International Space Station, it was called ARISS (Amateur Radio on the International Space Station). He said that I could present a project to my school principal and obtain permission to embark on the program."

Interviewer: "And you went to see your school director?"

Cédric: "Yes, and she said that she liked the program and she would present it to all the teachers. And that's how the project got started at my school."

Interviewer: "So, you got to talk with Chris Hadfield, a Canadian astronaut, what did you think of that?"

Cédric: "It was very exciting and very interesting."

Interviewer: "Do you think you would like to become an astronaut?"

Cédric: "Yes, because it sounds like a lot of fun and it is very special."

This is the story of a young student who had a dream and he overcame all obstacles to accomplish it. He presented his project to his school director and under the guidance of his parents and school staff he had a whole school involved.

Addition to the curriculum to cover space, satellites and astronauts; school wide competition to write questions for Chris Hadfield and to design posters; coordination from a local Amateur Radio club; selection of a proper date and time for the contact; involvement of the School Board; support

from external organizations such as the Cosmodome; presentations to the press and public; invitations to dignitaries; and interviews such as the one above, were all tasks completed for this project.

Before the contact took place, someone tweeted Chris Hadfield on the ISS informing him of Cédric's venture. Chris responded with a personal message to Cédric saying: "Bonjour Cédric, Merci pour l'invitation de parler avec vous! J'ai hate de savoir toutes les questions. Felicitations a votre originalite et vos efforts! A bientot - Chris."

(Good day Cédric, thanks for the invitation to talk with you. I look forward to receive all the questions. Congratulations for your originality and your efforts! Till then - Chris)

Upon successful completion of the ARISS contact, it goes without saying that they had one proud budding astronaut hailed at the school and through the community. Cédric will forever cherish this moment.

Thanks to the Canada Science and Technology Museum for opening a window to space for young visitors and a career goal for them to strive for.



Cédric Coté in a play suit, shortly after visiting the Science museum.



Ecole des Cardinaux, Ste Rose de Laval, school staff and Cédric (front row to the left) showing their ARISS poster. Notice Chris Hadfield photo in the background. Third from the right is Joel, VE2WIZ, the Amateur Radio coordinator for the event.

Alan Biddle, WA4SCA, Corporate Secretary October 25 & 26, 2012 Orlando, Florida

The meeting was called to order by AMSAT President Barry Baines, WD4ASW, at 0807 EDT on Thursday, October 25th, 2012.

Members of the Board of Directors present:

- Barry Baines, WD4ASW, President
- Lou McFadin, W5DID
- Drew Glasbrenner, KO4MA, Vice-President, Operations
- Gould Smith, WA4SXM, Vice-President, User Services
- Alan Biddle, WA4SCA, Secretary
- Tony Monteiro, AA2TX, Vice-President, Engineering
- Mark Hammond, N8MH, Vice-President for Educational Relations, First Alternate

Other officers present:

- Keith Baker, KB1SF/VA3KSF, Treasurer
- Martha Saragovitz, Manager

Among the AMSAT members participating and/or observing during the Board meeting were:

- Bill Reed, NX5R
- Bill Tynan, W3XO
- Bob Davis, KF4KSS
- Bryan Klofas, KF6ZEO
- Burns Fisher, W2BFJ
- Dale Hunzeker, KJ6VUC
- Dan Schultz, N8FGV
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- Nick Pugh, K5QXJ
- Phil Karn, KA9Q
- Steve Belter, N9IP
- Steve Coy, K8UD
- Steve Culp, K8QKY

Barry opened by welcoming the Board members and visitors. He introduced the

newly reelected Board members, and then presented the slate of AMSAT Officers for approval:

- President, Barry Baines, WD4ASW
- Vice-President, Operations, Drew Glasbrenner, KO4MA
- Vice-President, User Services, Gould Smith, WA4SXM
- Vice-President, Engineering, Tony Monteiro, AA2TX
- Vice-President Human Spaceflight, Frank Bauer, KA3HDO
- Vice-President for Educational Relations, Mark Hammond, N8MH
- Secretary, Alan Biddle, WA4SCA
- Treasurer, Keith Baker, KB1SF/VA3KSF
- Manager, Martha Saragovitz

The confirmation of the slate of Officers was moved by Barry, seconded by Gould, and approved by the unanimous consent of the Board. The following Officer positions are currently open:

- Executive Vice-President
- Vice-President, Marketing

Barry reviewed the schedule of Board and General Meeting events, including revisions and closed sessions.

Executive and Other Team Reports

President's report by Barry Baines, WD4ASW

Barry previewed the key points of his general report to the membership at the 30th Annual AMSAT Annual Meeting. Our goal of Keeping Amateur Radio in Space has continuing challenges, but the present picture is good, and the future looks bright. He complimented the AMSAT Engineering Team which has made excellent progress in the Fox Project.

A second but integral part of implementing this goal is the developing emphasis on education, the strengthening of our relationship with the ARRL, and our participation in the NASA Teaching from Space initiative. The ARISS contacts are also continuing to be popular and effective.

Barry also reviewed the recent issues with the AMSAT store. Due to security

issues, it was taken off line in May. After being moved to a secure system with new software, it is now back. This period had a surprisingly large impact on membership renewals, sales, and AMSAT's general Internet presence. He continued that these issues have renewed interest in upgrading and consolidating AMSAT's Information Technology functions, which are currently somewhat fragmented, and make changes difficult to implement.

ITAR, the International Traffic in Arms Regulation, continues to limit AMSAT-NA's ability to interact with foreign groups. It also has a significant impact on universities. Barry reported that there is growing interest in revising the current rules, but that this will not happen until the next Congress, at the earliest. Even the proposed legislation would prevent us from collaborating on a new Phase 3E satellite if it were launched on a Chinese vehicle. Bill Tynan, W3XO, emphasized that we need to monitor very carefully legislation in the new Congress. Non-profits such as AMSAT-NA and universities have had varied, inconsistent responses to ITAR issues. These types of organizations do not fit the normal picture held by regulators and legislators, and can inadvertently be adversely impacted by legislation and regulations.

Barry welcomed Mark Hammond, N8MH as Vice-President for Educational Relations, and the return of Frank Bauer, KA3HDO to the office of Vice-President, Human Spaceflight. He moved on to a discussion of membership and volunteers. Membership continues to decline slowly, which is challenging from both a financial and personnel resources standpoint.

There was broad agreement that a more effective volunteer intake mechanism was needed. The current web form is not as targeted as is needed by our current operations. It was suggested that direct e-mail or other contact from the applicant to the person handling a particular project might be more effective. Tony suggested a formal apprenticeship program to reduce the number of volunteers who quickly dropped out. Drew observed that volunteering is a two way street, and that AMSAT needs to support its volunteers more aggressively.

Barry concluded by emphasizing that AMSAT-NA is building a record of



success. This will allow us to attract new members, spacecraft partners, and donors. (The complete report can be found in the Proceedings of the AMSAT-NA 30th Space Symposium and AMSAT-NA Annual Meeting.)

Secretary's report by Alan Biddle, WA4SCA

Alan began by requesting a formal approval of the minutes of the 2011 San Jose, CA Board of Directors General Meeting as provisionally published in the Nov/Dec 2011 issue of the AMSAT Journal. This was moved by Drew, seconded by Gould, and approved unanimously.

He then reviewed significant administrative actions over the past year. Unusually, no other formal Board meetings besides the 2011 annual meeting were held.

Alan also discussed the 2012 Board of Directors election. This year's Board election went smoothly, with sufficient nominations being made by the traditional paper petition process. All written petitions were gathered at the Dayton Hamvention. One nomination was sent by electronic means, with a reminder that a confirming hard copy nomination was needed. This year 3176 ballots were sent, with 700 returned. This was a 22% rate compared with a 25% return rate in 2011, and was roughly comparable to that returned in 2009. A contributing issue to low response rates which we have encountered is that members, primarily non-US, are not receiving their ballots in a timely fashion, or at all. The usual cause is that the member did not renew, but it has happened with a few Life Members. Next year we will be reminding members by ANS and the mailing lists that they should have received a ballot, and to contact the office if they have not. Ballots outside North America are already sent via airmail.

Finally, the GoToMeeting software is working very well and has resulted in a marked reduction in travel costs. Its use is slowly expanding to support Board, technical, educational, and other AMSAT activities.

Open Treasurer's Report by Keith Baker, KB1SF/WA3KSF

Keith again reviewed the ramifications of AMSAT-NA's change from an in-depth "full up" financial audit of our accounting system to a somewhat less comprehensive yearly "review". This approach is now proving simpler, cheaper (and more in keeping

with the current practice of similar-sized organizations) without also sacrificing needed financial accountability.

Also, in the past, a "full up" audit of our financial system was needed for AMSAT to retain its eligibility to raise funds via the Combined Federal Campaign (CFC). However, due to other, far more stringent CFC eligibility requirements, AMSAT no longer meets the CFC's participation criteria. Therefore, even if we did qualify for continued participation in CFC, the anticipated costs of complying with the new CFC rules (i.e. a "full up" audit) would now far outweigh the anticipated financial gain from this source. So, at least for the foreseeable future, AMSAT will no longer participate in the CFC program.

Keith also reminded the Board that while volunteer time donated to AMSAT's efforts is no longer being captured and reported as capitalized assets in our financial system, it is essential that members continue to log their time on the AMSAT Volunteer Reporting System. This information will continue to be added as a footnote to our annual financial review documentation and may (yet) prove important in discussions with future, non-amateur radio-related donors.

Keith described AMSAT's financial situation as worrisome, although not yet critical. The slow decline in our membership, combined with the AMSAT store being off line for several months, has forced the use of some reserve funds to underwrite normal operations. While the recent rise in the stock market has helped offset this issue somewhat, continued uncertainty in the US economy as a whole along with uncertainty surrounding Fox-1's final development costs require continued caution in how we spend our financial resources and require a renewed search for additional revenue streams. Expanded use of on-line conferencing software for various AMSAT activities has been a significant benefit in reducing overall travel and other meeting costs.

Martha distributed the latest financial review report from Berlin, Ramos for approval. It was moved by Barry and seconded by Alan, that the report be accepted, and that Berlin, Ramos be retained as our independent financial reviewer for the coming year. The motion was approved unanimously.

Manager's report by Martha Saragovitz

AMSAT office operations have changed very little over the past year. The two volunteers

continue to provide invaluable help, but due to health and age issues can be expected to have less time available in the future. The process of upgrading the databases continues. The facility rent should continue at the current level. While the building has several vacant offices, new businesses nearby have resulted in more people in the area which aids security. Finally, having the AMSAT store open again has improved the cash flow. There are some issues to be addressed, but the process is going well.

Satellite Operations Report by Drew Glasbrenner, KO4MA

AO-51 continues out of service. There is a remote possibility of limited recovery if a battery cell opens. AO-27 and SO-50 are heavily used. FO-29 and VO-52, using the Dutch transponder, are seeing increased use. Several ISIS satellites will have the FM/DSB voice capability demonstrated in AO-16 and will provide more opportunities for communications. Despite some reports, AO-10 continues to be inoperative.

Drew expressed concern over the continued encroachment of commercial and quasi-commercial satellite operations into dedicated amateur frequencies. Some groups seem not to fully understand the legal and operational issues these cause. AMSAT-NA needs to make formal complaints to the FCC where appropriate. Proper spectrum management is needed for all concerned.

AMSAT-NA Board member Tom Clark, K3IO joined the meeting at 1045 EDT.

AMSAT-NA Facilities Report by Lou McFadin, W5DID

Lou reported on the AMSAT facilities in Central Florida. Continuing arrangements have been made for storage and work areas for future satellite development. The current storage area is air conditioned and secure. The thermal/vacuum test equipment is operational, but is being upgraded for automatic operation to improve data collection and reduce operator workload.

AMSAT Journal Report by Barry Baines, WD4ASW

The AMSAT Journal is a critical part of AMSAT, and continues to be of concern. Due to personal and professional issues, the new editor was unable to complete the transition effectively. One consequence, explained by Martha, is that AMSAT is in danger of losing its non-profit mailing permit. A 2nd class permit will not add significantly to



the costs, but will result in longer delivery delays. A waiver is being sought. Barry announced that JoAnne Maenpaa, K9JKM, has agreed to become the new editor. She has been an associate editor of both the AMSAT Journal and the ANS. While there have been production issues, the real limiting factor is in submissions. There are many good articles in other national AMSATs which may be translated and reported.

User Services Report by Gould Smith, WA4SXM

Gould reviewed in detail the AMSAT membership and participation levels. All show a continued slow decline. Satellite activity as reflected by awards is level or increasing slightly. He reported that Lee McLamb, KU4OS would be taking over as editor of the AMSAT News Service. Because of the loss of other members of the team, there is a need for several new volunteers to assist in the preparation of releases.

The temporary closure of the AMSAT store posed a significant problem for sales. There is a need for new items in all categories. Discussions are under way with the ARRL to carry some new hardware such as a broadband receive pre-amp, with the revenue to go to support the Fox Project. There is also the possibility of selling antennas. Drew suggested that we need to take a larger view and consider handling a range of satellite-related equipment.

Field Operations are somewhat hampered by the decreasing number of hamfests, and volunteers to support them. It was suggested that a listing of events with AMSAT representation be more prominently displayed on the AMSAT web page. Also, not all such events are logged on the FOSS system. HF nets are still functioning in the Internet Age, and there are some equivalent Echolink and linked repeater meetings. Dayton had good representation with improved support for the popular satellite contact demonstrations. The specialized "Fox Wear" has proved to be popular. It is planned to continue the AMSAT booth with 6 spaces in 2013, but to place the engineering area opposite the sales area rather than adjacent to it. This should provide for an easier interaction for both groups.

Educational Relations report by Mark Hammond, N8MH

Mark, our newest vice president, discussed the process of revitalizing existing resources such as the AMSAT-EDU mailing list. Additional, he is reaching out to develop

new working relationships with both organizations and individuals. These include ARISS review board participation, and the ARRL Education and Technology Program. Because of the stringent general rules intended to improve secondary education, it is necessary to align programs so that they fit within existing teaching and curriculum requirements. Barry asked whether, in light of NASA's desire for complete classroom programs, we should consider professional resources. Being developed for 2013 are classroom CubeSat and tracking simulators. Under consideration are loanable, deployable stations for direct ARISS contacts. There was a brief discussion involving several Board members and visitors, about the type of equipment which should be used. Martha reminded the meeting that there are significant issues in the safe handling of relatively fragile and expensive packages.

AMSAT Second Alternate Board member Patrick Stoddard, WD9EWK, joined the meeting at 1345 EDT.

ARISS reports by Dave Taylor, W8AAS

Dave, AMSAT's U.S. Delegate to the ARISS-I working group, discussed ARISS from an operational standpoint. The number of ISS contacts is increasing steadily, with Suni Williams on track to surpass Mike Finke's existing record. The TM-D700 in the Zvezda module continues to be used for voice contacts. The Erickson UHF equipment in the Columbus module is now operating as a simplex digipeater on 437.550 MHz with good results. A replacement Erickson VHF unit is expected to be delivered to the ISS in the near future, with the original unit being returned for study. There has been some turnover in the telebridge stations, and they are recruiting new contact mentors. Currently four are in the training process, with one graduate.

Looking to future developments, he reported that in 2013, the digital Ham TV should be delivered. Additional operation ground support will be required. Additionally, a Russian TM-D710E has been delivered for experimental use; it is not expected to be used for normal ARISS operations.

NASA personnel assigned to the project are now on a 6 month rotation, and are in the education office. Additionally, the more detailed selection process has resulted in some procedural changes. The results of these administrative changes are still being digested. There is an emphasis on direct rather than telebridge contacts. This adds

some immediacy to the student experience, but it also places the highest demands on mentors, local stations, and the schools involved. He finished by commenting that future developments will emphasize education, the development and flight of new hardware, and expanding the ops team.

AMSAT Symposium 2013

Barry and Martha talked about this year's and the upcoming Symposium. The Orlando Symposium is a good model of an efficient, well run meeting. Two important points are that responsibilities must be able to be delegated, and that there need to be enough local volunteers to support the myriad of expected and last minute items. AMSAT is looking for volunteers to host next year's meeting.

AMSAT Electronic Services by Gould Smith, WA4SXM and Joe Fitzgerald, KM1P

Gould reported that the databases have been migrated, but are not yet operational. The AMSAT store is up and running, with the operators still on a learning curve. A few configuration issues remain. Joe talked about some of the details involved with the store, and answered questions about the security implications of some of the options which have been discussed. He finished with a brief summary of the options for upkeep and customizations, including outside resources.

Barry then discussed the various components of the AMSAT electronic services. They are currently a collection of disparate systems and operators. He announced that Board Alternate Patrick Stoddard, WD9EWK has agreed to undertake a survey of the existing systems and make recommendations for future upgrades. He discussed his philosophy of the study, and of the possible directions which AMSAT can consider. He mentioned the possibility of working with other similar organizations which already have such an internet presence. Tom asked whether changing our hosting would allow us to allow advertising and other features not currently possible. He was interested in a comparison of websites of other similar organizations. Drew finished by strongly emphasizing that while we will need a range of people to operate the various components, there needs to be a single unified control of the various functions which will be fully compliant with the Board's policies.



AMSAT Engineering by Tony Monteiro, AA2TX

Tony discussed AMSAT's philosophy of obtaining free launches on a relatively regular, continuing basis. They are readily available so long as AMSAT is able to work with other groups and institutions. We will be providing communications and other support in exchange for the use of the equipment after or sometimes concurrently with the primary mission. Tony walked the Board through the process of applying for a launch under the NASA CubeSat Launch Initiative, formerly called the Educational Launch of Nanosatellites. We have already been accepted for one launch, but not yet manifested. He then discussed other proposals which AMSAT has been part of to date. Not all of these can be made public initially, but some, if accepted, will have government funding. All current proposals are for the initial Fox-1 or minor variations, rather than the Fox-2 configuration. Our greatest "market" is for research rather than engineering departments.

Tony then moved to the actual engineering process. The intent is to develop the new generation of satellites in a way which minimizes risk. (The full report spans several papers which can be found in the Proceedings of the AMSAT-NA 30th Space Symposium and AMSAT-NA Annual Meeting.) Each step will be incremental, with validation of the design. Of particular concern are that the RF systems work as desired, and that the entire system is tolerant to the maximum extent of the radiation environment. He reported that one problem is the turnover of volunteers, but that this is being managed. After mentioning several new volunteers, he finished by emphasizing that university student involvement has not just been a training exercise. Real, useful products have resulted.

The meeting broke for dinner at 1800 EDT, and resumed in closed session at 1900 EDT. It returned to open status at 2005 EDT for a review of the next day's events, before adjourning for the night at 2037 EDT.

The meeting resumed in closed session at 0910 EDT to discuss financial, operational, and other issues. The meeting returned to open status at 1150 EDT.

After a brief discussion of budget matters, Board members gave their nominations for individuals and groups deserving special recognition.

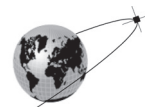
The following people were cited for their

particular contributions to AMSAT and its mission over the past year by various members of the Board and other officers:

- The Pacifcon 2012 AMSAT Team for presentations, demonstrations, and booth operations: Mark Hammond, N8MH; Dale Hunzeker, KJ6VUC; Joe Spier, K6WAO; Tom Deeble, KA6SIP; Alan Bowker, WA6DNR; EMike McCardel, KC8YLD.
- Peter Portanova, WB2OQQ for his successful congressional liaison on ITAR and related issues.
- Carol Malfatti, CPA and the firm of Berlin, Ramos for their continuing financial advice and support.
- Lou McFadin, W5DID and Dave Jordan, AA4KN, for organizing the exceptional AMSAT 2012 Symposium.
- Dan Shultz, N8FQV for editing and producing the AMSAT 2012 Symposium Proceedings.
- Tony Monteiro, AA2TX, for heading the Fox Team, his excellent grantsmanship, and the outstanding Fox Team Symposium Talks.
- Bob Carpenter, W3OTC for converting the AMSAT office dBase files and scripts.
- Bill Hook, W3QBC for his faithful office service and support of the AMSAT Journal.
- Martha Saragovitz, for keeping AMSAT and the AMSAT office running.
- The AMSAT Store team; Joe Fitzgerald, KM1P; Bruce Page, KK5DO, Gould Smith, WA4SXM; Alan Biddle, WA4SCA.
- JoAnne Maenpaa, K9JKM for assuming editorship of the AMSAT Journal.
- Dayton Amateur Radio Association, for their continuing financial support, and their support of our presence at the Hamvention.
- The Lake Monroe Amateur Radio Society for their outstanding support of the AMSAT 2012 Symposium.
- The Symposium prize team for the remarkable number and quality of prizes: Bill Tynan, W3XO; Dennis Veselka, KI4KNC; Jim Diggs, K4AHO; Dave Jordan, AA4KN; Lou McFadin W5DID.

- Bill Tynan, W3XO on his receiving the 2012 Barry Goldwater Amateur Radio Award from the Radio Club of America.
- Barry Baines, WD4ASW for his mentorship and support in the development of the new Vice President for Educational Relations.
- Remembrance of AMSAT members we have lost in the past year: Dee Interdonato, NB2F; Dick Daniels, W4PUJ; John Beanland, G3BVU.

There being no further issues, it was move by Lou, seconded by Gould, and unanimously approved by the Board, that the meeting be adjourned at 1128 EDT. ☸



Apogee View - continued from page 4 ...

The DVD also has the complete Proceedings papers for prior years beginning in 1986 as well. The DVD content conveys the quality of the papers presented and the range of discussions that take place each year.

Symposium is an outstanding experience for learning the latest in what is happening with AMSAT's engineering projects and other technical discussions. The Annual Meeting is a venue for informing the membership of the state of the organization and provides a venue for members to ask questions about the direction and status of Radio Amateur Satellite Corp.

I hope that you will consider joining us in Houston and be part of an outstanding event that will allow you to interact with the AMSAT engineering team as well as with the AMSAT leadership.

73, Barry A. Baines, WD4ASW ☸



In the AMSAT Store ...

<http://store.amsat.org/catalog>

2012 AMSAT Fox Tee shirt. Sand colored tee with Fox logo and CubeSat image across the front.



Bruce Paige, KK5DO (kk5do@arri.net) AMSAT Director of Awards and Contests

It's that time of year again; summer and Field Day! Each year the American Radio Relay League (ARRL) sponsors Field Day as a "picnic, a campout, practice for emergencies, an informal contest and, most of all, FUN!". The event takes place during a 24-hour period on the fourth weekend of June. For 2013 the event takes place during a 27-hour period from 1800 UTC on Saturday June 22, 2013 through 2100 UTC on Sunday June 23, 2013. Those who set up prior to 1800 UTC on June 23 can operate only 24 hours. The Radio Amateur Satellite Corporation (AMSAT) promotes its own version of Field Day for operation via the amateur satellites, held concurrently with the ARRL event.

With the loss of FM satellites of AO-27, AO-51 and SO-67 an FM contact during field day this year it is going to be challenging. If you are considering using the ONLY the FM voice satellite, SaudiSat-Oscar-50, for your AMSAT Field Day focus: DON'T, unless you are simply hoping to make one contact for the ARRL rules bonus points. The congestion on FM LEO satellites was so intense in prior years that we must continue to limit their use to one-QSO-per-FM-satellite. This includes the International Space Station. You will be allowed one QSO if the ISS is operating Voice. You will also be allowed one digital QSO with the ISS or any other digital, non-store-and-forward, packet satellite (if operational).

It was suggested during past field days that a control station be allowed to coordinate contacts on the FM satellites. There is nothing in the rules that would prohibit this. This is nothing more than a single station working multiple QSO's. If a station were to act as a control station and give QSO's to every other field day station, the control station would still only be allowed to turn in one QSO per FM satellite while the other station would be able to submit one QSO.

The format for the message exchange on the ISS or other digital packet satellite is an unproto packet to the other station (3-way exchange required) with all the same information as normally exchanged for ARRL Field Day, e.g.:

W6NWG de KK5DO 2A STX
KK5DO de W6NWG QSL 5A SDG
W6NWG de KK5DO QSL

If you have worked the satellites on Field Day in recent years, you may have noticed a

lot of good contacts can be made on some of the less-populated, low-earth-orbit satellites like Fuji-OSCAR 29 (may or may not be operational), AMSAT-OSCAR 7. During Field Day the transponders come alive like 20 meters on a weekend. The good news is that the transponders on these satellites will support multiple simultaneous contacts. The bad news is that you can't use FM, just low duty-cycle modes like SSB and CW.

2013 AMSAT Field Day Rules

The AMSAT Field Day 2013 event is open to all Amateur Radio operators. Amateurs are to use the exchange as specified in ARRL rules for Field Day. The AMSAT competition is to encourage the use of all amateur satellites, both analog and digital. Note that no points will be credited for any contacts beyond the ONE allowed via each single-channel FM satellite. Operators are encouraged not to make any extra contacts via these satellites (Ex: AO-27 & SO-50). CW contacts and digital contacts are worth three points as outlined below.

Analog Transponders

ARRL rules apply, except:

- Each phone, CW, and digital segment ON EACH SATELLITE TRANSPONDER is considered to be a separate band.
- CW and digital (RTTY, PSK-31, etc.) contacts count THREE points each.
- Stations are limited to one (1) completed QSO on any single channel FM satellite. If a satellite has multiple modes such as V/u and L/s modes both turned on, one contact each is allowed. If the PBBS is on - see Pacsats below, ISS (1 phone and 1 digital), Contacts with the ISS crew will count for one contact if they are active. PCSat (I, II, etc.) (1 digital),
- The use of more than one transmitter at the same time on a single satellite transponder is prohibited.

Digital Transponders

For the Pacsats (GO-32, etc.) or 'Store and Forward' hamsats, each satellite is considered a separate band. Do not post "CQ" messages. Simply upload ONE greeting message to each satellite and download as many greeting messages as possible from each satellite.

The subject of the uploaded file should be posted as Field Day Greetings, addressed to ALL. The purpose of this portion of the competition is to demonstrate digital satellite communications to other Field Day participants and observers. Do not reply to the Field Day Greetings addressed to ALL.

The following uploads and downloads count as three-point digital contacts.

- (a) Upload of a satellite Field Day Greetings file (one per satellite).
- (b) Download of Satellite Field Day Greetings files posted by other stations. Downloads of non-Field Day files or messages not addressed to ALL are not to be counted for the event. Save DIR listings and message files for later "proof of contact."

Please note AMSAT uploaded messages do not count for QSO points under the ARRL rules.

Satellite digipeat QSO's and APRS short-message contacts are worth three points each, but must be complete verified two-way exchanges. **Remember, only one digipeat contact is allowed for the ISS and other satellites in this mode.**

The use of terrestrial gateway stations or internet gateways (i.e. EchoLink, IRLP, etc.) to uplink/downlink is not allowed.

Sample Satellite Field Day Greetings File:

Greetings from W5MSQ Field Day Satellite station near Katy, Texas, EL-29, with 20 participants, operating class 2A, in the AMSAT-Houston group with the Houston Amateur Television Society and the Houston QRP club. All the best and 73!

Note that the message stated the call, name of the group, operating class, where they were located (the grid square would be helpful) and how many operators were in attendance.

Operating Class

Stations operating portable and using emergency power (as per ARRL Field Day rules) are in a separate operating class from those at home connected to commercial power. On the report form simply check off Emergency or Commercial for the Power Source and be sure to specify your ARRL operating class (2A, 1C, etc.).



Submitting Your Results

The Satellite Summary Sheet for submitting your AMSAT Field Day results is posted on-line at:

<http://www.amsatnet.com/2013fd.docx>
<http://www.amsatnet.com/2013fd.pdf>

The Satellite Summary Sheet should be used for submission of the AMSAT Field Day competition and be received by KK5DO (email or postal mail) by 11:59 P.M. CDT, Monday, July 08, 2013. The preferred method for submitting your log is via e-mail to kk5do@amsat.org or kk5do@arrl.net.

You may also use the postal service but give plenty of time for your results to arrive by the submission date. Add photographs or other interesting information that can be used in an article for the Journal.

You will receive an email back (within one or two days) from me when I receive your email submission. If you do not receive a confirmation message, then I have not received your submission. Try sending it again or send it to my other email address.

If mailing your submission, the address is:

Bruce Paige, KK5DO
 Director of Awards and Contests
 PO Box 310
 Alief, TX 77411-0310.

Certificates will be awarded to the first-place emergency power/portable station at the AMSAT General Meeting and Space Symposium in the fall of 2013. Certificates will also be awarded to the second and third place portable/emergency operation in addition to the first-place home station running on emergency power. A station submitting high, award-winning scores will be requested to send in dupe sheets for analog contacts and message listings for digital downloads.

You may have multiple rig difficulties, antenna failures, computer glitches, generator disasters, tropical storms, and there may even be satellite problems, but the goal is to test your ability to operate in an emergency situation. Try different gear. Demonstrate satellite operations to hams that don't even know the HAMSATS exist. Test your equipment. Avoid making more than ONE contact via the FM-only voice HAMSATS or the ISS, and enjoy the event!



AMSAT is the North American distributor of **SatPC32**, a tracking program designed for ham satellite applications. For Windows 95, 98, NT, ME, 2000, XP, Vista, Windows 7.

Version 12.8b is compatible with Windows 7 and features enhanced support for tuning multiple radios.

Version 12.8b features:

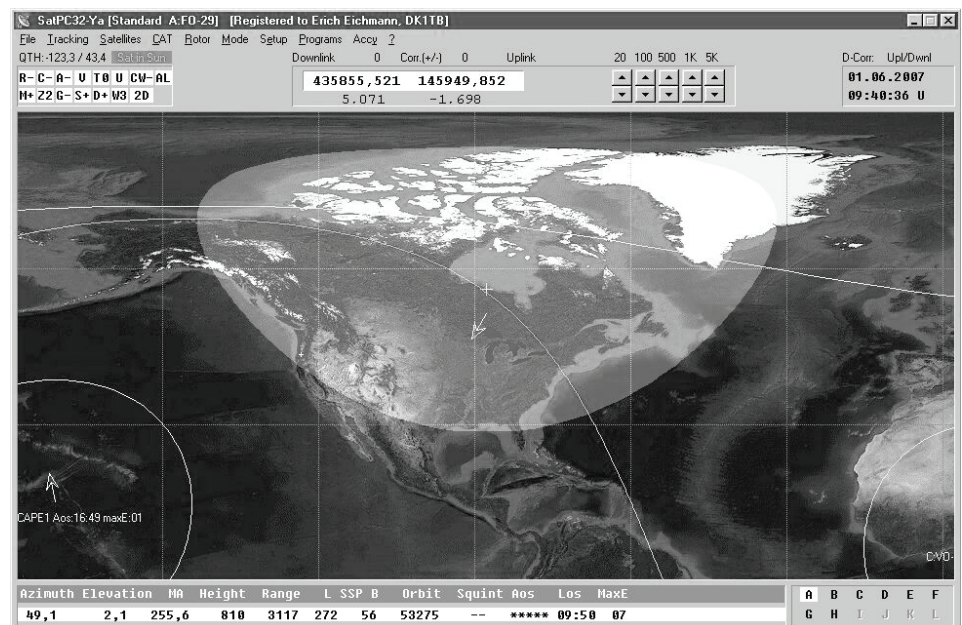
- SatPC32, SatPC32ISS, Wisat32 and SuM now support rotor control of the M2 RC-2800 rotor system.
- The CAT control functions of SatPC32, SatPC32ISS and Wisat32 have been expanded. The programs now provide CAT control of the new Icom transceiver IC-9100.
- The main windows of SatPC32 and SatPC32ISS have been slightly changed to make them clearer. With window size W3 the world map can be stretched (only SatPC32).
- The accuracy of the rotor positions can now be adjusted for the particular rotor controller. SatPC32 therefore can output the rotor positions with 0, 1 or 2 decimals. Corrections of the antenna positions can automatically be saved. In previous versions that had to be done manually.
- The tool 'DataBackup' has been added. The tool allows users to save the SatPC32 program data via mouse click and to restore them if necessary. After the program has been configured for the user's equipment the settings should be saved with 'DataBackup'. If problems occur later, the program can easily restore the working configuration.
- The rotor interfaces IF-100, FODTrack, RifPC and KCT require the kernel driver IOPort.SYS to be installed. Since it is a 32-bit driver it will not work on 64-bit Windows systems. On such systems the driver can cause error messages. To prevent such messages the driver can now optionally be deactivated.
- SuM now outputs a DDE string with azimuth and elevation, that can be evaluated by client programs. Some demo files show how to program and configure the client.

Minimum Donation is \$45 for AMSAT members, \$50 for non-members, on CD-ROM. A demo version may be downloaded from <http://www.dk1tb.de/indexeng.htm>

A registration password for the demo version may be obtained for a minimum donation of \$40 for members and \$45 for non-members.

Order by calling 1-888-322-6728.

The author DK1TB donated SatPC32 to AMSAT. All proceeds support AMSAT.



David A. Palmer, KB5WIA, kb5wia@amsat.org



Figure 1: FUNcube Dongle Pro+

The moon is yet another satellite within the reach of ham radio operators. A software-defined receiver coupled with MAP65 software will allow the amateur radio Earth-Moon-Earth (EME) operator to visualize the entire EME sub-band at once. This can be a great benefit to satellite operators getting started in EME. Monitoring the entire spectrum will simultaneously show the locations of other stations strong enough for your system to decode.

This article describes how to install a FUNcube Dongle Pro+ (FCDPP) software defined radio (SDR) into an existing EME station. It assumes that the operator is already familiar with EME exchanges using the JT65B protocol, has experience with WSJT software, and has basic EME station hardware.

Hardware

A typical EME-capable station will have a mast-mounted preamplifier, sequencer, and separate transmit (TX) and receive (RX) lines. For my 144 MHz EME station, I use two M-Squared (M2) 2M7 antennas, coupled with an M2 power divider, feeding an Advanced Receiver Research (AR²) SP144VDG GaAsFET preamplifier with +24 dB gain. The received signal is sent through a separate RX coaxial cable (75 feet of RG-8/U) to a hybrid splitter combiner (a Mini-Circuits ZFSC 2-2 Power Splitter, 10-1000 MHz). The FCDPP (Figure 1) is connected directly to the output of the splitter with the other port connected directly to the analog radio.

Appropriate coaxial relays are controlled by a dedicated sequencer and protect the mast-mounted preamplifier, switching between the separate TX and RX lines. I also found it helpful to add a dedicated coaxial relay to switch the input of the splitter to a 50-ohm dummy load during transmission; this also helps to prevent spurious JT65B decodings.

The main hardware list is shown here:

- antenna(s)
- a sequencer,
- a mast-mounted low-noise amplifier (LNA),
- an A/B coaxial RF relay at the mast (high-power),
- separate RX and TX lines (RG-213 or RG-8/U is suitable for RX side),
- a high-power amplifier in the TX line,
- a low-power A/B coaxial RF relay in the shack,
- a 2-port hybrid splitter,
- an SDR (in this case, the FCDPP),
- traditional transceiver and WSJT9 software,
- a multi-core microprocessor (MAP65 requires more computing capability than WSJT), and
- a second 1080p monitor (optional, but recommended).

If separate TX and RX lines are not used, careful attention needs to be paid to protecting the FCDPP receiver from damage during transmission. The configuration settings described in this article will likely need to be optimized if station hardware differs significantly from the above. It should, however, provide a good starting point.

Computer Settings

A reasonably fast computer is required—those with multi-core processors should be fine for this purpose. Both Linrad and MAP65 can require a fair amount of memory, so the machine should have lots of RAM as well.

The instructions presented in this article are

written with the Windows 7 operating system in mind. Also, it is advised to disable any power saving options on the computer used to run the SDR.

Installing The FUNcube Dongle Pro+

A. Software

One should first read the user manual for the FDCPP and install the software according to the directions. The main steps include:

- obtain documentation at: http://www.funcubedongle.com/?page_id=1225,
- download FCHid,
- download SDRSharp,
- install both programs,
- verify that the FCDPP demodulates signals,
- update the FCDPP firmware to the latest version, and
- verify again that the FCDPP demodulates signals.

The FCDPP is really an amazing little device—it doesn't need a driver which has to be installed, and it's pretty much plug and play.

You could skip all of the above steps, plug the unit in, and start using it with Linrad and MAP65. However, it's good practice to verify that it's working, and to update the firmware, as described above.

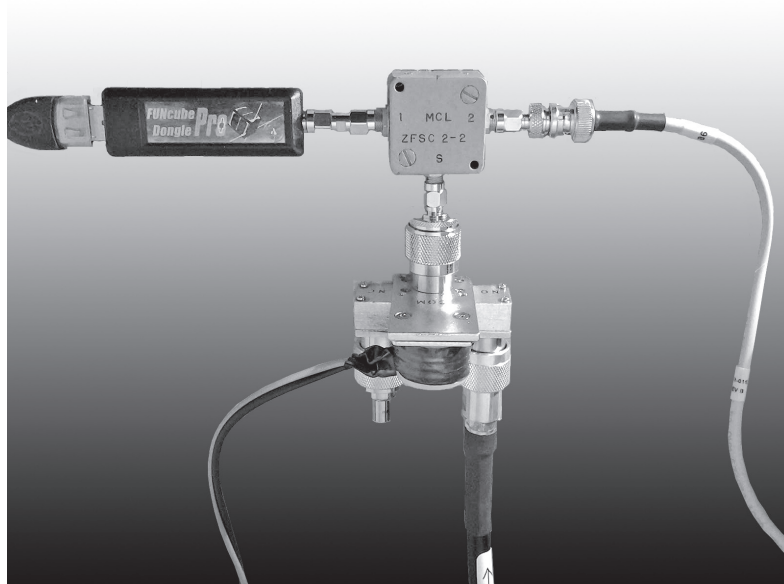


Figure 2: FUNcube Dongle Pro + attached to hybrid splitter-combiner.

B. Hardware

The FCDPP can be attached directly to the computer's USB port, but some operators have reported that it's better to use a short USB extension cable. This allows the FCDPP to be physically separated from the computer (thereby reducing RF ingress) and also takes some of the strain off of the USB connector. I have not had any RFI problems myself, but I use a 3-foot USB extension cable with a ferrite core.

The FCDPP is attached to a hybrid splitter-combiner (Figure 2). The input of the splitter is attached to a Tohtsu CX-520 coaxial relay, which switches between the receive coaxial cable and a 50-ohm load. The second output of the splitter connects to the Yaesu FT-817ND radio via a second TX/RX relay.

Installing MAP65

First create the hard drive folder:

C:\MAP65

Download and install MAP65 from at the website of Joe Taylor K1JT:

<http://www.physics.princeton.edu/pulsar/K1JT/map65.html>.

Comprehensive installation directions and an excellent manual are included on Joe's webpage. Just follow the instructions step by step but be sure to install the software in that folder. The main screen is shown in Figure 3.

Installing And Setting Up Linrad

A. Downloading And Installation

The installation described in this article is based on Linrad 03.46, which I find works well with MAP65 and is a good starting point. Note that Linrad is updated periodically and, as of March 2013, the latest version is Linrad 03.47. Once you become familiar with Linrad you can update to the latest version if desired.

To start off the installation, make a folder called:

C:\ham\linrad\linrad346_funcube_pp

and download KB5WIA's Linrad-FCDPP configuration file from:

http://zdap.com/radio/kb5wia_linrad_346.zip.

Next, extract all of the contents of this file and save them in the folder you just created. You should see two FCDPLUS files, and other files all in the same folder. In my experience, the dynamic link library (DLL) files needed by Linrad are already installed by MAP65, but if

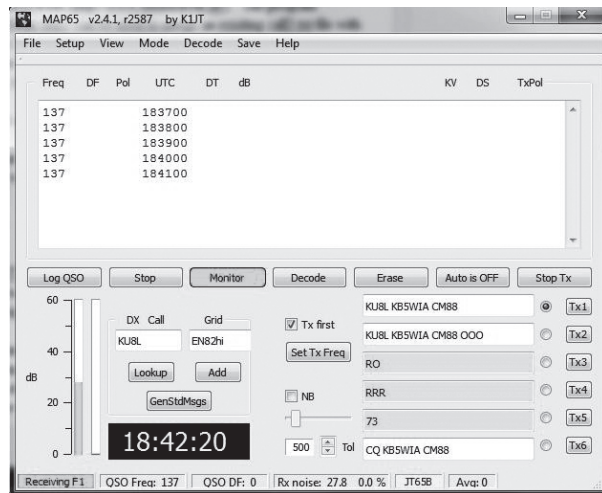
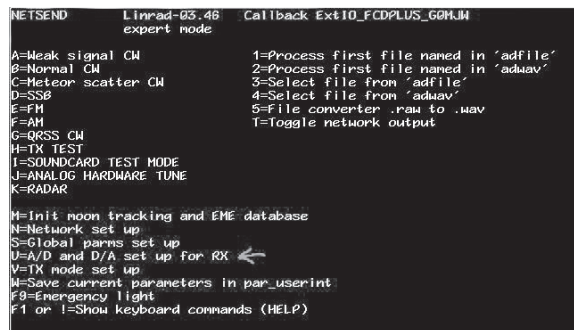


Figure 3: MAP65 main screen.



(left) Figure 4: Linrad main screen.

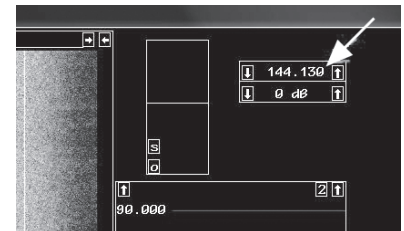


Figure 5: (right) Setting receiving frequency in Linrad.

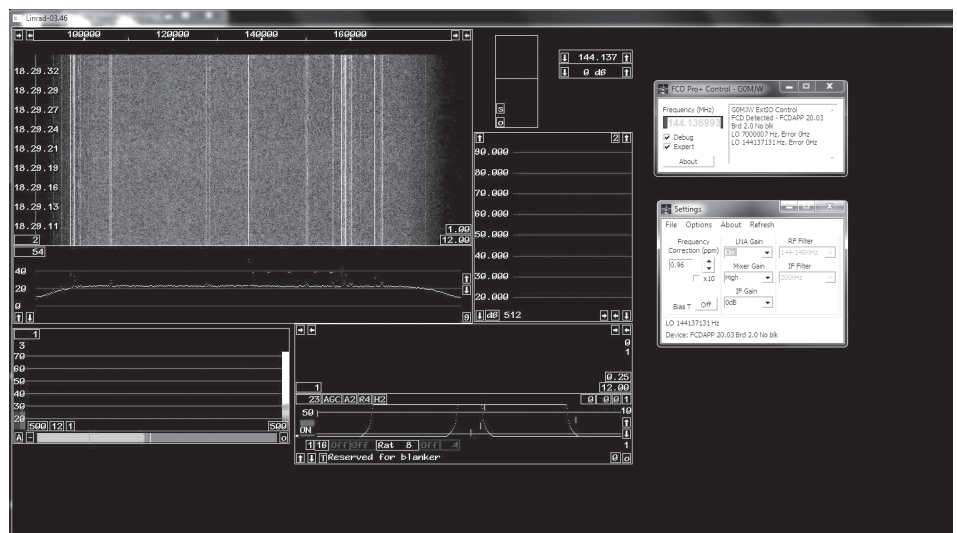


Figure 6: Linrad waterfall and display during operation.



you get an error message indicating that they are missing, they are available from the website of Leif Åsbrink SM5BSZ at:

<http://www.sm5bsz.com/linuxdsp/linrad.htm>.

Simply click on the link labelled “**setup-linrad-dll-package-02.exe**” and download the file. Click on it when it’s on your hard drive and it will install the necessary DLL files on your computer. Make sure to install the program as an administrator.

Alternatively, advanced users can install Linrad from scratch, instructions are given in the References and Notes section of this article¹.

Finally, make a folder called: **C:\linrad_data**.

B. Setting Up Linrad

B-1. USB Port

The following instructions tell Linrad which USB port your FCDPP is plugged into. Note that you should always plug the device into the exact same USB port, otherwise you’ll have to follow all these steps again. Note also that in the following instructions, “<ENTER>” means “press the enter key”.

To start Linrad, go to:

C:\ham\linrad\linrad346_funcube_pp

and double-click on “linrad.exe”. The main screen should appear (Figure 4). When it does, verify that: “Callback ExtIO_FCDPLUS_G0MJW” appears in the top right-hand corner. This tells you that Linrad has found the ExtIO DLL, which controls the FCDPP. If that phrase does not appear, go back and double-check that your configuration files are in the Linrad directory. Once that is verified, the remaining steps are as follows:

- press U,
- press A (Change the Input Settings),
- press F (LibextIO hardwares),
- press 0 <ENTER>
- (ExtIO_FCDPLUS_G0MJW.dll),
- press N <ENTER>, (Inverted Spectrum), press any key and wait 10 seconds, and
- Press N (portaudio for rx input).

B-2. Sound Card

Now choose the sound card device number that corresponds to your FCDPP. This shows an example, using soundcard 2:

- press 2 <ENTER> (selects soundcard 2),
- press N <ENTER> (more channels),
- press N <ENTER> (extended format),

- type in 96000 <ENTER> (sampling speed),
- press 2 <ENTER> (direct conversion),
- type 0 <ENTER> (one audio channel), and
- type 0 <ENTER> (receiver hardware undef).

Even though it’s not required for MAP65, the following steps will tell Linrad to send the SDR output from the audio to your speaker:

- press B (output soundcard options), and
- press N (portaudio for receiver output).

Choose the sound card device number that corresponds to the soundcard your PC speakers are connected to. If, say, it’s 0, you’ll type 0 <ENTER>.

B-3. Saving Settings

The next steps should be followed otherwise nothing you just did will be saved:

- press X (to main menu),
- press any key, and
- press W (save current parameters).

B-4. Running Linrad

Now press the “ESC” key to close Linrad and restart it.

From now on, whenever you run Linrad, you only need to press “D” to put it into SSB mode. You can type in your center frequency on the top right corner to tune the FCDPP (Figure 5). A frequency of 144.130 MHz is good. This feature also controls the center frequency in MAP65.

You can now minimize Linrad and not worry about it. Press “ESC” on Linrad to close the program when you’re ready to shut it down.

Figure 6 shows Linrad’s main screen during normal operation. The wideband waterfall is in the upper left.

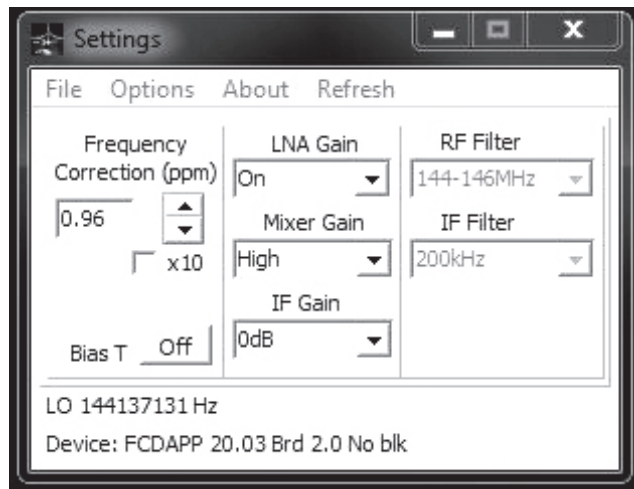


Figure 7: Hardware setting for FUNcube Dongle Pro +

If you want to learn more about Linrad, Leif SM5BSZ has lots of information on his website

<http://www.sm5bsz.com/linuxdsp/usage/newco/newcomer.htm>.

You can also move the cursor of your mouse to any part of the Linrad screen and press F1 to bring up a description of what that control does.

B-5. Backing Up Data

Once everything works, make a backup copy of the folder located at:

C:\ham\linrad\linrad346_funcube_pp

and keep it in a safe place, such as on a USB stick. Use this copy in case a mistake was made with a Linrad setting and it can’t be fixed. To revert to your backup, simply copy the saved files into this folder.

Configuring The FUNcube Dongle Pro+

The initial defaults for the FCDPP hardware settings seem to be optimal. The LNA is ON, mixer gain is HIGH, IF Gain is 0 dB, and frequency correction is 0.96 ppm². The Bias T should be off, assuming that you’re not powering the preamplifier through the coaxial cable (Figure 7).

Note that the FCDPP is a different device than the original FUNcube Dongle Pro. The original units used a different tuner chip, with a different ExtIO control panel. The optimal settings for EME operation for the original units were 20-30 dB of LNA gain and 4 dB mixer gain. All of the following stages were set to their lowest gain value. The original device also needed a tight bandpass filter in front and a means of thermal stabilization to prevent frequency drift.

A narrow bandpass filter on the FCDPP is

automatically selected on the 2-meter band. Howard Long G6LVB redesigned the FCDPP to have a fairly tight surface acoustic wave (SAW) filter in the front end. This greatly limits the out-of-band sensitivity problems seen in earlier versions.

That being said, you may wish to experiment with a narrow bandpass filter in the RX line if you suspect out-of-band interference problems. For me, a 2-pole helical filter ahead of the FCDPP does not change performance significantly--the device's internal bandpass filter is sufficient.

Configuring Linrad

A. Documentation

Download, print, and review the following PDF files:

<http://vhfdx.radiocorner.net/pics/LinradScreen1.pdf> - and -

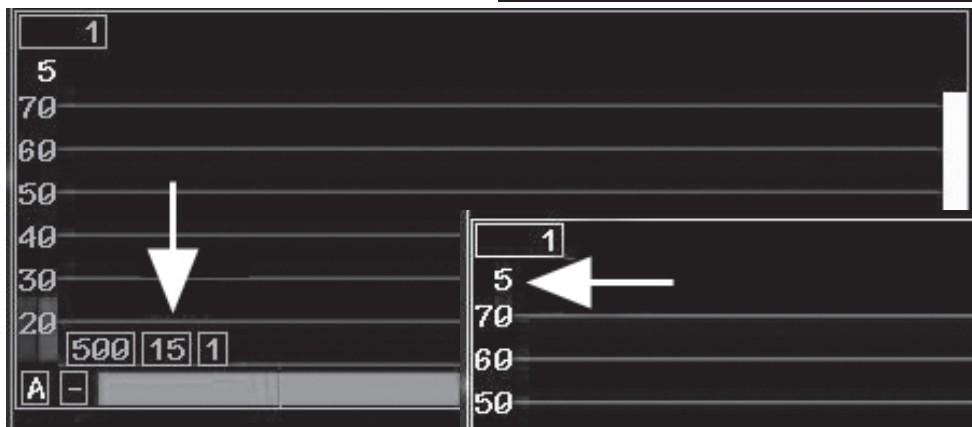
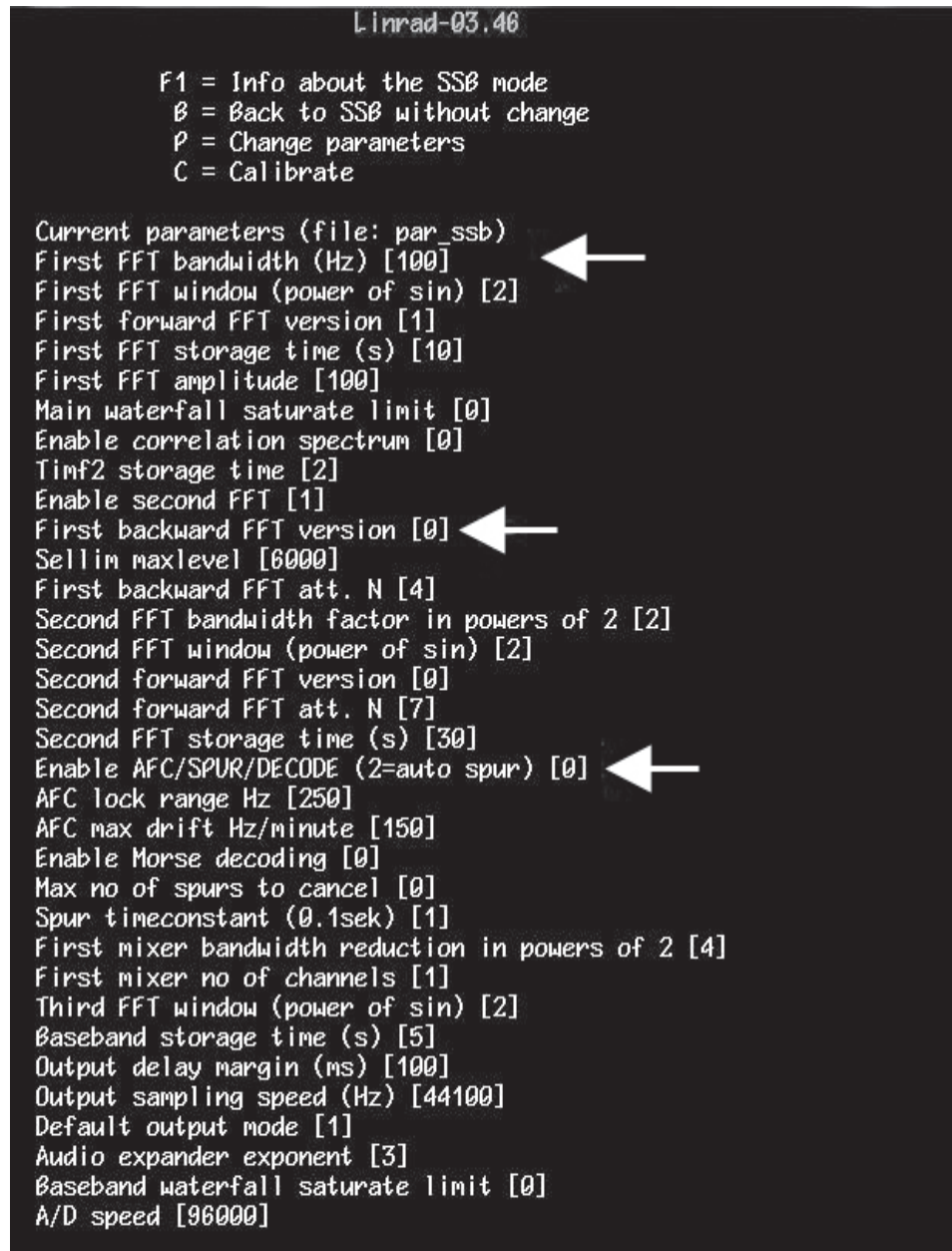
http://physics.princeton.edu/pulsar/K1JT/Linrad_On-Screen_Controls.pdf.

These will tell you what the many basic Linrad screen controls do.

B. Gain

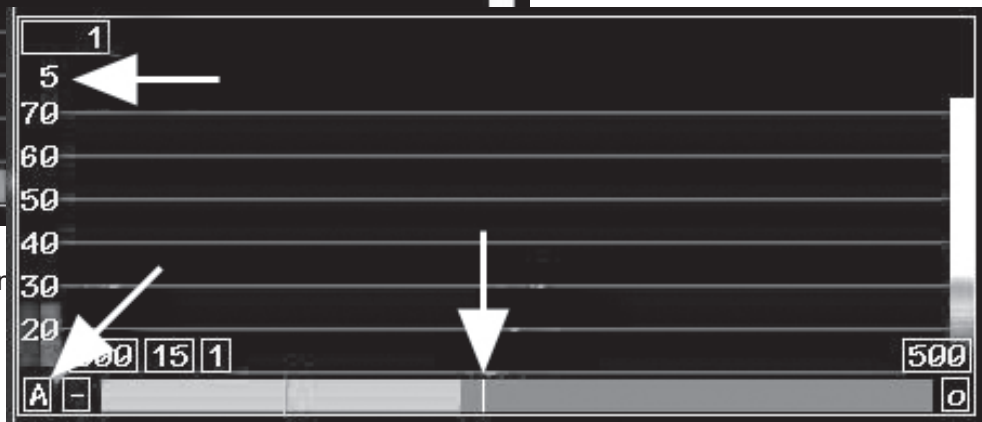
Start by adjusting the first Fast Fourier Transform (FFT) amplitude to a value of 100. (See Figure 8 for reference.) This feature is the equivalent of the front-end gain in Linrad. It will prevent the FCDPP from over-driving Linrad and causing a white or pink waterfall display. The steps for this are shown here:

- start Linrad,
- press D to enter SSB mode,



(above) Figure 8: FFT settings in Linrad.

(left) Figure 9: Attenuator setting in Linrad.



(right) Figure 10: Noise blanker setting in Linrad.

- press X to change settings,
- press P to change parameters,
- change the value of “First FFT Amplitude” to 100,
- press <ENTER>, and
- click “Continue” to reach the end of the parameter menu.

In the same manner, I also changed of “First backward FFT version” from 1 to 0. This tells Linrad to send 32-bit floating point data to MAP65, rather than processed 16-bit data. I’m not sure of any performance difference with this setting, but, at present, it makes sense to send all of Linrad’s data to MAP65.

I’ve also changed AFC/SPUR/DECODE to 0, since I have found that the auto-spur reduction does not affect the MAP65 waterfall. The SSB configuration settings I currently use are shown in Figure 8³.

Adjust the value for Linrad’s MAP65 output attenuation to 15. This helps to keep the MAP65 input signals in the necessary +20 to +30 dB range⁴. (Figure 9). In the lower left box that says [500][10][1] (or similar), change the middle value to 15.

C. Signal and Noise Blanking

On the same control (shown in Figure 9), disable the strong signal blanking on the MAP65 output. In the lower left box that says [500][10][1] (or something similar), change the right-hand value to 1. (This step is optional. In my location, I don’t have strong signals within the FCDPP passband.)

Also on the same control, turn on and adjust the Dumb Noise Blanker (NB) (Figure 10). (It’s called “dumb” to differentiate it from Linrad’s “smart” blanker.)

Optimal NB settings will depend on what type of local noise you have. Start at 5% blanking, and then adjust upwards or downwards on actual JT65B signals over many decodings to see if a different value works better. This is done as follows:

- in the box on the lower left of the high resolution spectrum, choose A,
- point and click your mouse on the yellow bar to the right of the bar graph underneath the high resolution spectrum, and
- drag the yellow bar back and forth with your mouse until the box in the upper left of the graph shows 5.

This sets the NB to automatic and blanking 5% of signals.

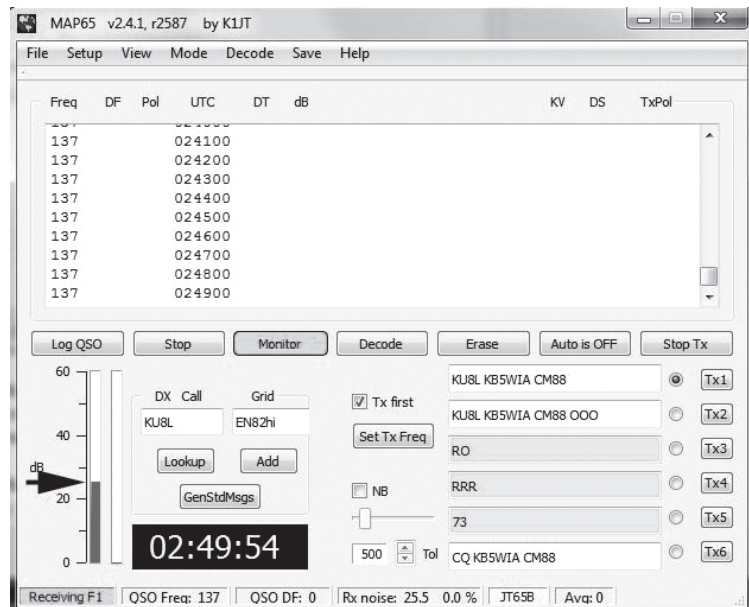


Figure 11: MAP65 receiving input via Linrad.

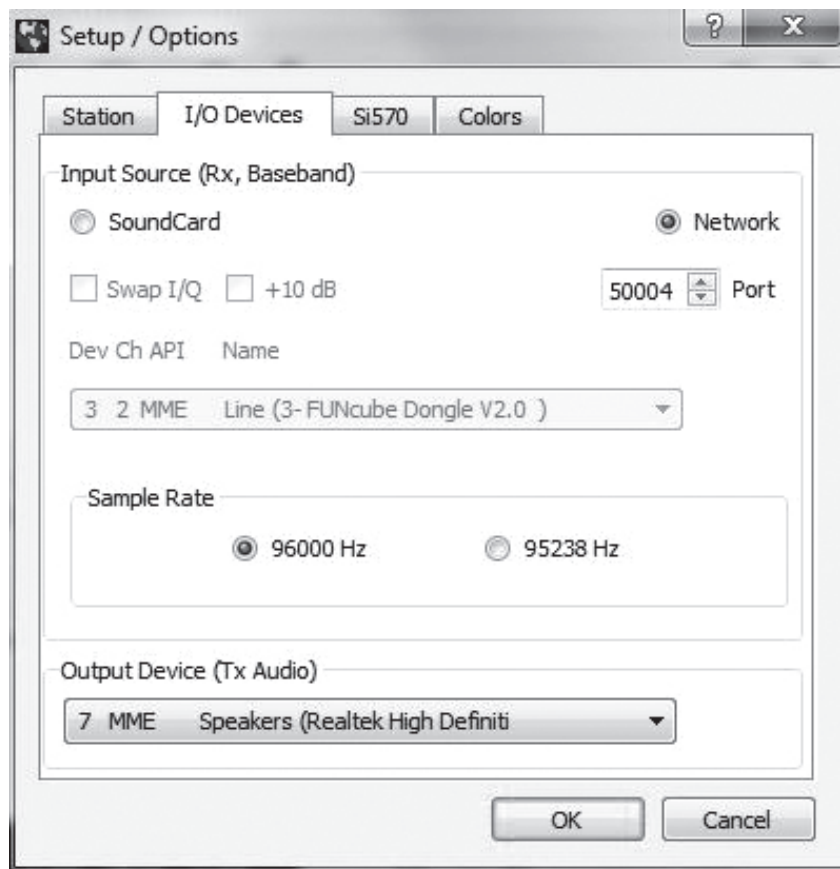


Figure 12: MAP65 port and sample rate settings for Linrad.

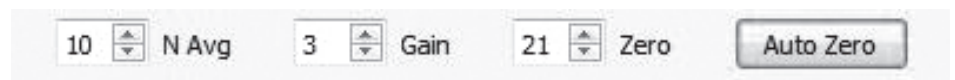


Figure 13: MAP65 waterfall setting.

Configuring MAP65

A. Data Input From Linrad

Start MAP65 and verify that it's receiving data from Linrad. If it is, the signal bar graph on the left side will turn green and will be showing some sort of amplitude (Figure 11).

If MAP65 isn't receiving data, check that the settings are as shown in Figure 12. Make sure it is set to receive data from Network, uses port 50004, is set for 96000 Hz sampling, and so on.

B. Noise Floor

Verify your noise floor. On my system, at this point, the noise floor on MAP65 will fluctuate around +23 dB with antennas pointed away from noise sources into a cold sky. It's also normal to see the noise levels go up by +8 dB when the antennas are pointed towards the horizon in a suburban environment.

C. Preamplifier

Verify that your preamplifier is functioning. Turn off the mast-mounted unit and verify that the noise floor drops significantly (at least 10 dB, preferably 20 dB). On my system, the noise floor drops to around +7 dB when power to the external +24 dB preamplifier is removed.

D. Waterfall Display

Adjust the NAvG on MAP65 to a value of 10, so that 1 minute of time corresponds to approximately 1 cm of vertical space on the waterfall. Averaging the lines (a slower waterfall) will help you see weak traces. (See Figure 13 for details.)

Zero the MAP65 waterfall brightness. After zeroing, it should be a blue color. Typically, I zero the waterfall with antennas pointed at the cold sky, so the color of the MAP65 waterfall can tell me how much local noise I'm receiving at any point in time. So:

- blue: nice and quiet,
- green: marginal, and
- orange and red: only the strongest signals will get through.

Increase the gain on the MAP65 waterfall to 5 or so to get more "snow". This will help you visualize weak traces better.

E. Noise Blanker

Don't run MAP65's noise blanker since the one for Linrad is turned on.

F. Frequencies

Verify that the frequency display is correct. Look for a birdie (or set of birdies) on the MAP65 wide screen waterfall. Note the frequency and tune your analog radio to the same frequency. Verify that you can see the same birdie(s) on both radios. On my system, they are pretty close, about 40 Hz apart.

Configure the MAP65 output to your analog radio (transmitter). For this, you'll need to specify the sound card output, and the COM port used to key the PTT line (Figure 14). These should be the same settings that you are using in WSJT9 software.

Try calling CQ on an open frequency and verify that the MAP65 transmissions and levels seem correct.

G. File Updates

The following information is important. Make sure you update MAP65's "call3.txt" file. Register and download the latest version of call3.txt from:

<http://www.mmmmonvhf.de/>

The program WSJTMerge from:

<http://www.k2txb.com/WsjtMerge.htm>

can be used to merge an existing "call3.txt" file with the new one.

Also, if you're not already in the Make More Miles on VHF Database:

<http://www.mmmmonvhf.de/dbase.php>

then you're potentially missing out on +4 dB of coding gain because other EME stations may not have you in their own "call3.txt" files. It is important that your callsign is in the "call3.txt" file from this site. If you're a small station, and you're not listed in the other station's "call3.txt" file, it's going to be much more difficult to have a QSO.

H. Search

Make sure to turn on aggressive deep search in MAP65.

I. Display Font

MAP65 has a setup option to change the font size in the Astronomical Data window. Set it to a one which allows you to see everything in the window, such as 12 or 14.

Using The System

With the configuration just described, you have

a system that can decode JT65B signals on two separate radios: the FCDPP and your traditional analog radio. With the settings described above, the FCDPP should have about the same sensitivity as your analog radio and be able to decode JT65B signals about as well.

By running both MAP65 and WSJT9 simultaneously, you now have a better means of decoding signals on the frequency you're looking at. For example, if one of the two radios is unable to decode a signal due to, for example, random noise, the other one may pick it up. You can also use one radio to check on the decoding of the other—for example, seeing both radios decode the same message virtually rules out the chance of a false result.

Moreover, you can now visualize the entire EME sub-band on the MAP65 waterfall, so you can quickly check other frequencies for active EME activity (Figure 15). Also, MAP65 has the band map/message list, and will decode signals from stations that you're not even looking for though with slightly reduced sensitivity. Figure 16 shows Linrad, MAP65, and WSJT9 running simultaneously, with both programs decoding EME signals independently.

Using MAP65 no longer limits you to finding stations calling CQ on the internet chat rooms. You'll find stations that your station can hear, since, by definition, MAP65 is only going to report to you the stations that you're capable of receiving. As a bonus, you can also quickly use MAP65, which displays the last 5-10 minutes of spectrum activity, to zero in on a station that you saw calling CQ in an internet chat room to see if you can find any traces of a signal.

You can also use the two radio systems (analog and digital) for optimizing one or the other. For example, you can experiment with different Linrad settings, or different filters, on the SDR side and make A/B comparisons with the decoding on the analog side. Given the high degree of variability in decoding of EME signals, having a direct A/B comparison greatly improves your ability to optimize one or the other.

Overall, the incorporation of an SDR and MAP65 into your station should greatly enhance your ability to make EME contacts, even with a smaller station.

Optional: Installing HDSDR For Satellites

With the FCDPP, you can see the entire passband of a linear transponder satellite at once. The program HDSDR can display a waterfall of the whole satellite downlink, and it has a very nice user interface.

I use HDSDR to monitor the entire VHF passband



of the U/V satellites (i. e., VO-52 and AO-7). To do this, start by making a folder called:

C:\ham\hdsdr.

Download HSDR from:

<http://www.hdsdr.de/>

and install into this folder. Also download the FCDPP ExtIO files from the “Hardware” page on the HSDR site, and place them into the folder you just created.

When you’re using the FCDPP to monitor the satellite downlink, even when you’re in an active QSO, you can see exactly what other stations are also on the satellite. It’s very easy to recognize CW signals, SSB conversations, and even other hams tuning up and trying to find their downlink.

Acknowledgements

The assistance from the W6YX team in getting this system working was greatly appreciated.

References and Notes

[1] One can, alternatively, install Linrad from scratch. Linrad can be downloaded from SM5BSZ’s website mentioned earlier in the article. The installation instructions are on the same page.

The necessary FCDPP ExtIO DLL and initialization files can be downloaded from the HSDR page at:

<http://www.hdsdr.de/hardware.html>.

The DLL and initialization files need to be located in the same folder as “linrad.exe”.

[2] You can also run the FCDPP with LNA set to ON and Mixer Gain at Low if you need extra dynamic range or linearity. If you do so, you’ll need to adjust Linrad’s “First FFT amplitude” value to around 500 in order to compensate for the reduced FCDPP gain. This alternate setting seems to result in fewer MAP65 decoding operations, and signal-to-noise values generally about -2 dB. Note, though, that your results may be somewhat different.

[3] With the settings I’m currently using, the combination of Linrad and MAP65 can decode just as well as my Yaesu FT-817ND transceiver with WSJT9 software. There are many factors that can be adjusted in Linrad, and what I have here is a starting point. It will be interesting to see what the ultimate consensus is on “best” settings for these programs.

[4] MAP65 seems to work well with a wide input range, but try to keep it in the +20 to +30 dB range. In my own experience, input levels above

+40 dB cause significantly reduced decodings.

[5] To obtain an FCDPP, Howard Long G6LVB has instructions for ordering one on his website. Start by going to:

<http://www.funcubedongle.com/>

and finding the tab called “The New FUNCube Dongle Pro+”. You can find out about how to order it right there. When I ordered mine, there was a waiting list of a few weeks. Put in your name and Howard will send you an e-mail message telling you when yours is ready to order. Pricing information is on the website also. Proceeds from these units go to AMSAT-UK’s FUNCube satellite project, so it’s also for a very good cause.

[6] For further support, there is a good Google group for Linrad that also has quite a bit of MAP65 information. There is also a Yahoo Group in the U. K. for the FCDPP at:

<http://uk.groups.yahoo.com/group/Fcdproplus/>.

[7] The original version of this article is located at: **<http://kb5wia.blogspot.com/2013/01/installing-map65-and-funcube-dongle-pro.html>** and contains more screenshots of the installation process. ☺

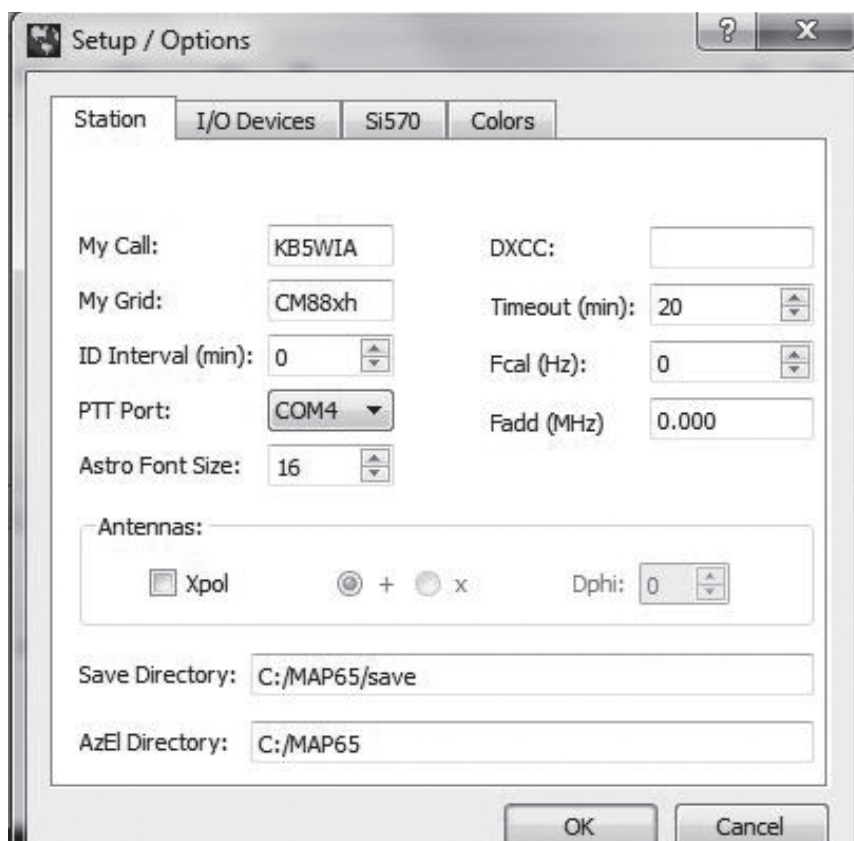
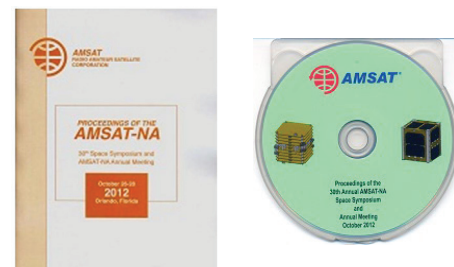


Figure 14: MAP65 audio routing configuration.



The Proceedings of the AMSAT-NA 30th Symposium and AMSAT-NA Annual Meeting, October 26-28 in Orlando, Florida are available in the on-line AMSAT Store.

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The proceedings contains over 30 articles on subjects ranging from current satellite operations to updates on the Fox Project.

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AMSAT-NA Board of Directors Nominations

It is time to submit nominations for the upcoming open seats on the AMSAT-NA Board of Directors. A nomination requires either one Member Society or five current individual members in good standing to nominate an AMSAT NA member for the position. Four director's terms expire this year:

- Barry Baines, WD4ASW
- Alan Biddle, WA4SCA
- Drew Glasbrenner, KO4MA
- Tony Monteiro, AA2TX

In addition to traditional submissions of written nominations, which remains unchanged and is the preferred method, nominations may be made by electronic means. These include e-mail, FAX, or electronic image of a petition. Electronic petitions should be sent to MARTHA@AMSAT.ORG or faxed to 301-608-3410.

Written nominations, consisting of names, calls and individual signatures should be mailed to: AMSAT-NA, 850 Sligo Ave #600, Silver Spring, MD, 20910.

No matter what means is used, petitions MUST arrive no later than June 15th at the AMSAT-NA office. If the nomination is a traditional written nomination, no other action is required. If it is other than this, i.e. electronic, a verifying traditional written petition MUST be received at the AMSAT-NA office at the above address within 7 days following the close of nominations on June 15th.

ELECTRONIC SUBMISSIONS WITHOUT THIS SECOND, WRITTEN VERIFICATION ARE NOT VALID UNDER THE EXISTING AMSAT-NA BYLAWS.



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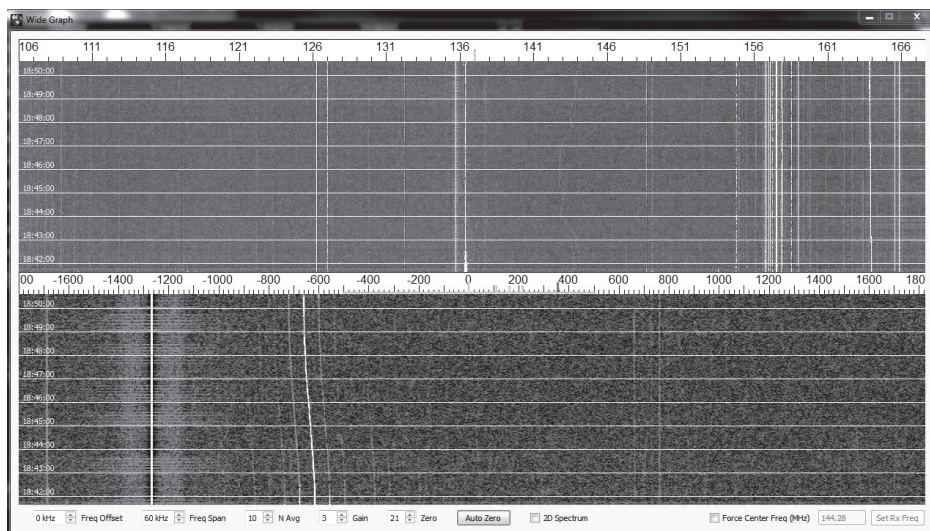


Figure 15: The wide graph is the main MAP65 waterfall display.

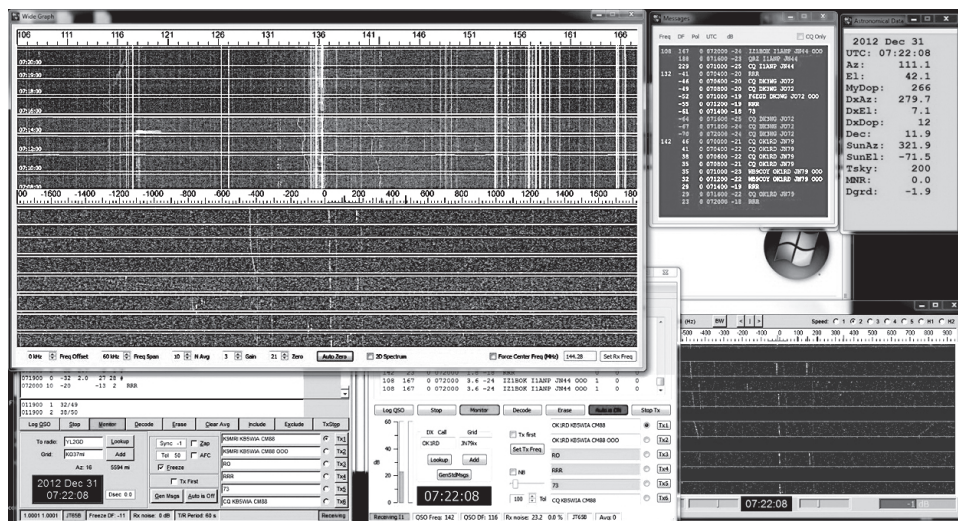


Figure 16: WSJT can operate simultaneously with MAP65.

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Ronald G. Parsons, W5RKN,
w5rkn@w5rkn.com

In order to avoid applying power to my preamps when I am not tracking a satellite, I built a little circuit from parts in my junk box to avoid this from happening. However the circuit could be used for many other purposes as it just energizes a DPDT relay whenever my satellite rotors are tracking.

The circuit is attached to the TXD serial data line from the computer to the rotor controller. Any data on that data line re-triggers a 12 second timer and as long as that timer is on, the relay is energized. I set the tracking software (SatPC32 in my case) to update the rotor controller every 5 seconds. So the relay is energized from the time the first command is sent to the rotor controller until 12 seconds after the last command is sent. Of course, you can adjust these times to suit your individual needs.

The schematic of the circuit is shown in the Figure. I built the circuit on a Radio Shack prototyping board and installed it in a small enclosure. The serial data cable from the computer is plugged into a 9-pin serial data jack on the enclosure and the serial data

cable from this circuit is plugged into an adjacent connector. All nine data lines are connected to the corresponding data line on each connector. The TXD line is also connected to the circuit. This line is pin 3 on a 9-pin serial connector.

A two- or three-pin connector of your choice can be mounted on the enclosure for each pole of the DPDT relay. I connected the two NO (normally open) pins to a pair of shorting switches wired to the corresponding Common pins so that the controlled circuit can be energized at the operators choice even if the relay is not energized. Each circuit can also be fused.

Circuit Description

The first gate from the LM1489 IC converts the RS-232 levels of the TXD line to TTL levels. The second gate inverts the signal from the first gate to the appropriate polarity for the B input of the timer IC. The duration of the output pulse of the timer 74LS123 is approximately $t = 0.45 RC$. For the values of R and C used, t is calculated to be about 9.9 seconds and an actual time of about 12

seconds. The output Q goes to two open collector gates of a 7407 IC, one gate activates the relay coil and the other an LED to indicate when the relay is energized.

Any generic PC board mounted relay which fits into a 16-pin DIP socket may be used; an example part is the Radio Shack 12 VDC Coil, DPDT Miniature PC Relay, part number 275-249.

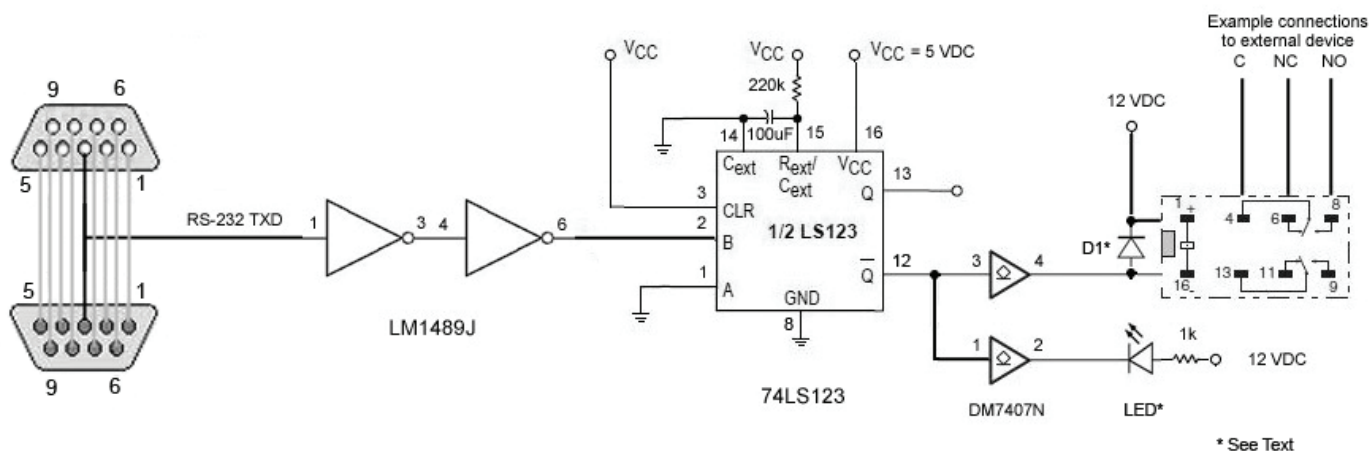
The LED was from my junk box. Diode D1 is used to shunt the kick-back voltage from the relay coil and any suitably rated diode can be used here.

For a 74LS123, the maximum value of R is 260 k Ω and for a 74123, the maximum value of R is 180 k Ω . There is no restriction on the value of C.

I used a 7805 voltage regulator to create the VCC of 5.0 volts from the 12 VDC supply.



Preamp Interlock Schematic



* See Text



RADIO AMATEUR SATELLITE CORPORATION

MAXIMUM POWER POINT TRACKER

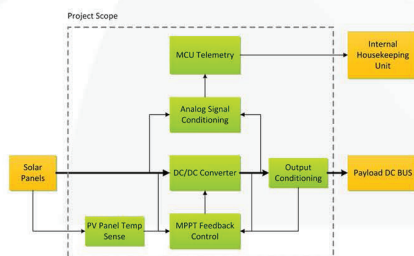
PROJECT BACKGROUND

The Radio Amateur Satellite Corporation (AMSAT) has been working to produce a new family of satellites to expand upon more than 40 years of flight heritage. The Fox family of satellites will be based on the CubeSat standard providing AMSAT with its next generation of spacecraft. The Fox-1 satellite is a small 1U CubeSat to be launched in 2013, while the Fox-2 satellite will be a larger 3U payload that will require upgraded power production capabilities.

P13271 has been tasked with providing AMSAT an engineering prototype of a *Maximum Power Point Tracker* (MPPT) design capable of handling the increased power requirements of the Fox-2 satellite. This project will be further developed into a flight ready design to be launched into orbit around 2015.

MAXIMIZING POWER

In order to maximize the power obtained from a solar array, each solar panel must be operated at a voltage that is largely dependent on temperature. A maximum power point tracker transforms the impedance of the solar panel to the impedance of the load. Tracking is performed by predicting the maximum power point voltage based on solar panel temperature and adjusting the panel voltage to match the predicted value. This transfers the maximum power available from the solar panel when required.



OBJECTIVES

- » Provide a proof-of-concept MPPT board to AMSAT
- » Maximize energy extraction from solar array
- » Survive extreme environment of space (i.e. temperature and radiation)
- » Report health and status information to the satellite's main computer

SPECIFICATIONS

- » Max. Power Output: 7.24 Watts
- » Max. Input Voltage: 22 Volts
- » Max. Output Voltage: 4.1 Volts
- » MPPT Response Time: <100 ms
- » MPPT Efficiency: >90%
- » Operational Temp. Range: -40 to 85 °C
- » Ionizing Radiation Expectation: 30 kRad TID
- » PCB Layout Area Constraint: 144.5 cm²
- » Component Height Restriction: 5 mm
- » IHU Communications

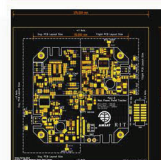


R.I.T.

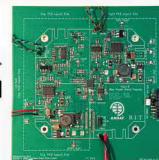
MISSION ASSURANCE

A robust design is required due to the mission critical nature of the maximum power point tracker. NASA derating was a technique applied to increase the margin of safety between component design limits and applied stresses, therefore reducing degradation and increasing reliability. In addition, ionizing radiation causes "wear and tear" on electronic components, and can lead to premature failure. Due to the expense of radiation-hardened devices, *commercial off the shelf* (COTS) components were used. COTS parts that exhibited radiation tolerance in published data were chosen whenever possible. When no suitable component with radiation test data could be found, a component with a radiation resistant structure was selected.

FINAL PRODUCT



Assembly >
Printed Circuit Board
<Design



The MPPT properly supplied the maximum power when necessary. During this test, solar panel temperature and irradiance were held constant as the MPPT output current was varied. The MPPT was tested using a solar panel to power a constant current load and a supercapacitor for energy storage. Load requires more power, which the MPPT provides. Load requests more power than the MPPT can deliver, and supercapacitors start discharging. Maximum power is delivered from the MPPT during this time. Load power requirement drops, MPPT moves away from delivering maximum power as it is no longer needed.

The MPPT properly tracked the maximum power point with panel temperature. During this test, solar panel irradiance was held constant as the solar panel RTD voltage and the MPPT output current were varied. The MPPT was tested using a solar panel to power a constant current load and using a potentiometer to simulate an RTD. Load forces MPPT to deliver maximum power. RTD is not properly set, MPPT behaves as though panel is cooler than it actually is. Maximum available power is not delivered. RTD voltage is decreased to represent a warmer panel. Power delivered to load is increased.

THE P13271 TEAM



Ian MacKenzie (EE)
Brent Salmi (EE)
Bryce Salmi (EE)
Dan Corriero (EE)



Faculty Guides: Leo Farnand & Vince Burolla
Faculty Sponsor: Dr. Dorin Patru
Customer: Tony Monteiro, VP of Engineering, AMSAT
Special Thanks to Gordon Davies

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LVB Tracker Box

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- Ethernet interface capable
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- Open architecture
- Built-in rotor interface cable with DIN connector
- Power supplied via the rotor controller cable
- Bi-directional interface allows the unit to read the rotor position
- LCD position readout
- Front panel manual control
- Self-programmable, allows for easy software upgrades
- Supported by the major tracking programs
- Uses GS-232A or Easycomm I/II protocols

Contact Martha at the AMSAT office 301-589-6062 to order.

The complete units will be built in groups, so get your orders in early. Units will be shipped as they become available.

Minimum donations requested for various configurations:

- 1) Bare board - \$20 + S&H – no parts kits available
- 2) Populated board, serial interface - \$100 + S&H – no kit with USB unit, rotor cable and LCD available, we do have a parts list with recommended part numbers and sources.
- 3) Custom Ten-Tec Enclosure powder coat, silk-screened, drilled/punched - \$50 + S&H
- 4) Complete unit - board, USB output, rotor cable, LCD, enclosure - \$200 + S&H **our most popular

Documentation for the LVB Tracker can be found at: <http://www.LVBTracker.com>

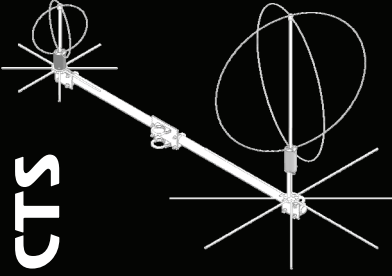
Boards and complete units may be ordered from the AMSAT office at 301-589-6062 or from martha@amsat.org



Mahana Paige, W5BTS and dad Bruce Paige, KK5DO set up and staffed the AMSAT Table at the Greater Houston Hamfest on March 23. This event was the South Texas Section Convention sponsored by the Brazos Valley Amateur Radio Club.

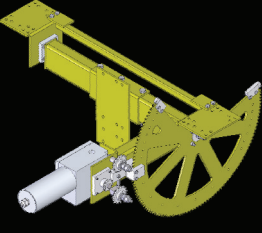


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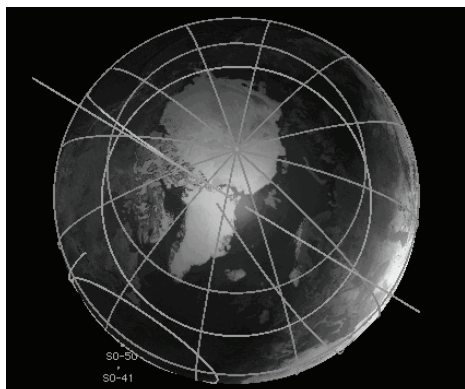
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Bob DeVarney, W1ICW w1icw at myfairpoint dot net

This month I will delve into one of the most hotly debated topics in moonbounce, preamps. I will discuss several good makers and pass along another tip or two.

The first suggestion I would make to any budding moonbounce operator is to run split transmit and receive feedlines when setting up your station. There are several good reasons for this, but I won't go into them here. Suffice it to say, all the serious moonbouncers run split tx/rx and you should too. There are instructions on the web for the mods necessary to most VHF/UHF rigs, and most are pretty straightforward. In my case, with my Elecraft XV-144 transverter, it was really simple to just install the extra optional connector and build it that way.

When running split tx/rx, you put one good, high power relay out at the antenna, and put your money into your transmit feedline so as to minimize power losses on the way to the antenna array. Since you have a preamp in line, you can run relatively inexpensive feedline on the receive side, even RG-8 if need be, as usually you have more than enough gain in the preamp to overcome feedline loss. But remember to minimize any losses ahead of the preamp! Every fraction of a dB in feedline loss ahead of your preamp adds to the noise figure of your preamp. So you can take a really nice multi-hundred dollar jewel and make it perform as poorly as the one you got at Radio Shack for 20 bucks by hobbling it with lossy coax in the antenna system. In my case, my feedline loss ahead of the preamp is a measured 0.26 dB which is as low as I can possibly get it. I could get it lower by moving the preamp and relay box up on the support mast, but then I would lose the ability to raise and lower the array at will and that's a tradeoff I am willing to live with. As it is, with this loss and a 0.35 dB gain preamp I hear quite well indeed.

At this point, you're probably saying to yourself, "all right already, just tell me which preamp to get!" So here goes. There are several choices for preamps and my first choice usually comes from Germany. Beginning with my early days of satellite operating, I ran a Landwehr preamp which later got replaced with the SSB SP-2 I still have in use today. I think the Germans really have this preamp thing down to an art form. When it came time to make a choice in early 2010, I was looking at either the SSB LNA145 or the DB6NT MKULNA144. At the time, the exchange rate favored the US a bit more, and I was

able to get the DB6NT slightly cheaper than the SSB product purchased domestically, so I went that route. I have to say that I was not disappointed. The DB6NT preamp is a thing of beauty, with a milled aluminum case, high quality connectors, and stainless hex socket head hardware on the connectors. Everything about this preamp says that the utmost in quality components were used in the construction. Just check it out on the DB6NT website and you'll see what I mean (<http://www.kuhne-electronic.de/en/products/low-noise-amplifiers.html>) What I like best about this preamp is that it is UNCONDITIONALLY stable, which is a good thing because one of the other makers preamps I tried tended to oscillate on my system.

Next choice would of course be the SSB preamp (<http://www.ssbusa.com/gaasfet.html>). If you MUST stick with a single feedline, they offer a switched mast-mount preamp capable of handling the full amateur limit (1.5 kW) This model is the MHP145 and the specs look really good on it. Given my past experience with SSB products (almost 20 years with two of them in the air and not a single issue) I would not hesitate to recommend their product. If you're running split tx/rx, then the LNA145 would be a good choice.

The next choice I am aware of would be the preamps from Advanced Receiver Research in Burlington, CT (<http://www.advancedreceiver.com/page2.html>). I've used their preamps for various projects over the years including an SP28VD for a Mode A ground station (10 meters down, 2 meters up) using a Radio Shack HTX-100 and a Yaesu FT-290R. I also used one in the shack for hearing the rather anemic downlink from RS-15 back in the day. Their SP144VDG would be a good choice for a receive-only preamp out at the array, but it's right at the upper limit of what I would call an acceptable noise figure for EME use. Their mast mount preamp, specifically the MSP144VDG-160, has good specs, but is rather light in the power handling department (only 160 watts) for any serious EME work.

Next up would be the preamps from Pete, WA2ODO. Pete has won an amazing number of awards in noise figure contests at the different VHF conferences, and his preamps are used on many if not MOST of the moonbounce DXpeditions and by many of the top stations. They are quite reasonable in price and usually have sub 0.1 dB noise

figures. I used one of his older designs here for the first 6 months or so, then tried one of his ultra-low NF preamps, but it tended to oscillate on my system. I traded it off to a friend who says it works fine on his system. What I would say about that is if the SWR of your system is very good, say below 1.25:1, then his preamps will undoubtedly work very well for you. My SWR tends to run a bit high (around 1.4:1) and I had problems. I believe he has been working on his design to find a tradeoff between bleeding-edge noise figures and stability, but only know this second-hand. Pete's e-mail is wa2odo@gmail.com

Lastly, as an honorable mention, I would suggest the AD6IW design preamp. These are available from Goran as a bare, postage stamp-sized board (or they were anyway) based on his article in the DUBUS magazine. You can add helical filters ahead of and behind them based on your band of choice. I built one up wideband (no filtering) and plan to use it on 1296 at some point. I see from his website that he offers assembled and tested complete preamps for 800 to 2400 MHz. If you are interested in something for 2 meters, I would suggest contacting him directly. I have a friend who is using one of his preamps on his EME system and loves it. It is also an UNCONDITIONALLY stable design. Refer to <http://www.ad6iw.com/>

I am sure there are other preamps out there that I haven't covered, and their omission here is strictly due to my ignorance, and I apologize up front for any that I have missed. It should be mentioned that ALL of the receive-only preamps MUST be used with a sequencer, and the mast-mount preamps SHOULD be used with a sequencer. Downeast Microwave makes a nice kit version (the TRSCK) for 85 bucks if you like building, or you could purchase ready-made from either DEMI, Advanced Receiver (TRS04VD, which is an assembled and tested board only) or SSB DCW-15B specifically for their preamps. As always, follow the instructions in the manufacturer's literature for best results. Nothing spoils a moonbouncer's day faster than blowing up his or her four-hundred dollar imported preamp the day of a big contest or DXpedition.

That's about it for this time. As always, feel free to email me with comments or questions. It's been great to receive emails from readers, and keep the feedback and questions coming!



John M. Franke, WA4WDL, jmfranke@cox.net

Many AMSAT members have interest in satellites other than those designed and used for amateur radio. This includes meteorological, communication, deep space probes, Earth resource, and even classified satellites. I started with OSCAR III, then low orbit meteorological satellites of the ITOS series, geostationary weather satellites, low orbit US and Soviet navigation satellites and finally GPS. All satellite interest groups can benefit from sharing knowledge and experience with each other. One area I have recently been interested in is the scientific satellites operating in the 2.2 to 2.3 GHz band.

A good reference site for S-band reception, <http://www.uhf-satcom.com/sband/> confirms the band as being 2.2 - 2.3 GHz. Another good S-band reception reference site is: <http://www.svengrahn.pp.se/trackind/UpOnSband/UpOnSband.htm>.

I believe now is a good time for S-band receiver experimentation with other satellites so I will be ready when the next amateur radio S-band transponder is orbited. With the increased interest in cubesats, which have limited surface area for antennas, I am hoping to see S-band activity increase.

In previous articles¹⁻⁵, I have described how easy it is to salvage useful parts and sections from MMDS downconverters. It occurred to me I could use the local oscillator (LO) output band pass filter as a much needed RF input filter for a 2.2 to 2.3 GHz receiver. From previous tests of the LO, my guess was the LO filter should already be set up for covering 2.228 to 2.328 GHz and might need little if any retuning.

Background

Since the days of AO-13, many MMDS downconverters like the Drake 2880⁶ and California Amplifier models 31732⁷ and 130016⁸ have been modified for amateur satellite reception. I have been looking into other possible modifications and applications. I purchased a box of fifteen California Amplifier model 130001 and 130002 MMDS (Multichannel Multipoint Distribution Service) downconverters

from an online auction for less than \$1.50 each, including shipping. Like many downconverters designed for MMDS, the RF input range is 2,500 – 2,686 MHz and the IF output range is 222 – 408 MHz. Some downconverters like the California Amplifier model 31732 are designed to cover two bands: 2.152 – 2.162 GHz with an IF of 116 – 128 MHz and 2.5 – 2.686 GHz with an IF of 222 – 408 MHz. In all but a few cases, the LO frequency is 2278.0 MHz and the internal reference crystal frequency is 8.8944 MHz. A California Amplifier downconverter without a cover is shown in Photo A. An enlarged view of the LO and LO output filter is shown in Photo B.

The downconverters typically have a type “N” RF input connector and two type “F” IF output connectors. One F connector serves double duty as the IF output and the dc power input. The second F connector provides an output test port 20 dB down from the normal IF output. The downconverters are powered from an external +16 to +24V supply and have an internal type 78M12A 12V three-terminal voltage regulator. While this article focuses on the 130002 downconverter, the information is general enough for a multitude of California Amplifier MMDS converters.

Salvaging the filter

Using a hand nibbler, I removed the LO bandpass filter from a model 130002 California Amplifier Downconverter and added SMA printed circuit board edge connectors, see Photo C. I did not even have to destroy a downconverter for this test. The filter was actually salvaged from a LO section I had previously salvaged and subsequently damaged. One end of the filter is direct coupled and the center pin is grounded for dc. For the other end, I left the 220pF series connected SMT capacitor in place. The capacitor was already in place and I felt I might someday have a need for the line to have a dc block. The salvaged circuit board measures 31/32” wide by 1-1/4” high and could be cut even smaller. It would be easy to reduce the height to 1-1/16”.

I took discrete transmission loss measurements on the interdigital bandpass filter using a Hewlett-Packard model 431B RF power meter and a Wavetek 2002A sweep generator. I had tried the sweep function, but the signal generator output had excessive ripple and I do not have a log response detector. Instead, I measured the input power and output power to the California Amplifier filter at

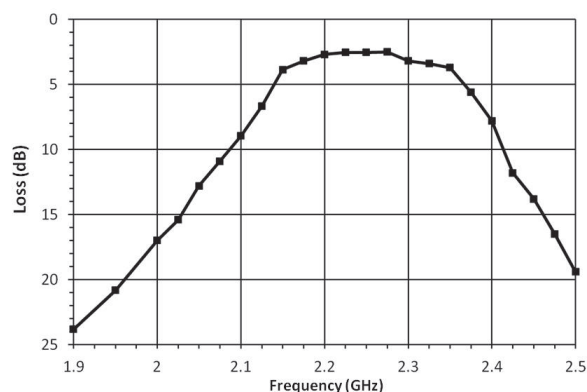


Figure 1 - LO Bandpass Filter Frequency Response

multiple points from 1.90 to 2.50 GHz. The frequency at each point was measured with my homemade 2.8 GHz frequency counter³, the prescaler for which was salvaged from another California Amplifier downconverter. The frequency meter was coupled to the signal generator through a 10 dB directional coupler. I calculated the filter transmission loss at each of 23 points. The data is depicted in Figure 1.

The LO filter has a measured insertion loss of approximately 2.5 dB. The 3dB points are roughly 2140 MHz and 2375 MHz. The filter is a bit wider than I hoped, but far better than anything I have or could afford to purchase off the shelf. A Hearsat newsgroup member, Loren Moline WA7SKT, had recommended and uses a Mini-Circuits model VBFZ-2340-S+ filter which drops to 2.2dB at 2.020 GHz and at 2.660 GHz. The minimum loss, at 2.34 GHz, is 1.51dB. The VBFZ-2340-S+ costs \$39.95 in single quantities. The salvaged filter is better (narrower frequency response) and much cheaper. The results are true for the filter I measured. One should expect minor variation from filter to filter. I decided to mount the filter in a small shielded case. The case is primarily for physical security.

Mounting the Filter

I used one of my homemade shielded boxes⁹ which are made from thick-walled square aluminum tubing; 1.5" x 1.5" x 1.125" with 1/8" thick walls, and 0.050" thick end plates held in place with a total of eight 2-56 screws. I had to file a 1/4" square hole in each of the end plates for the SMA connector flanges. The square holes match the ends of the SMA connectors and prevent the circuit board from twisting when the input and output connections are mated or loosened. The lateral offset between input and output SMA connectors is approximately 3/8". First, I mounted the printed circuit board on a metal spacer using a countersunk 4-40 screw. The spacer passes through a pre-existing hole in the printed circuit board. The spacer adds physical support to the flexible printed circuit board. Then, I drilled and filed the square holes in two oversize end plates, leaving more than sufficient metal surrounding the holes. I temporarily held the end plates in place with a c-clamp and scribed the location outline of the enclosure. I used my set of guide plates to mark and start the holes

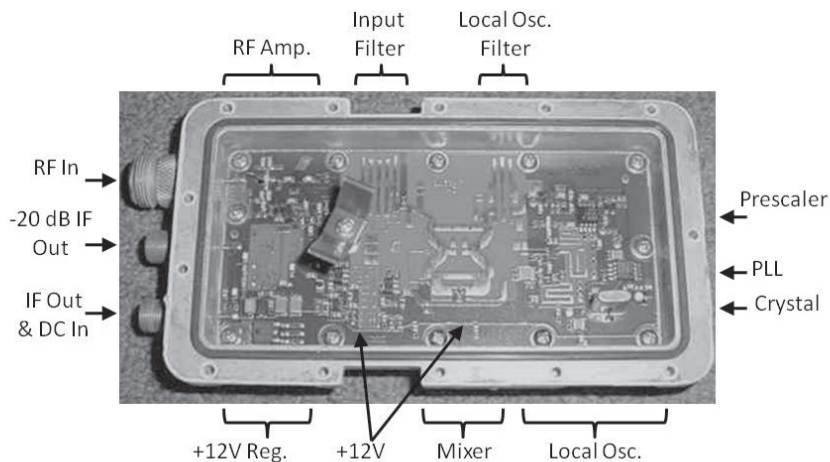


Photo A - Cal Amp Downconverter Interior

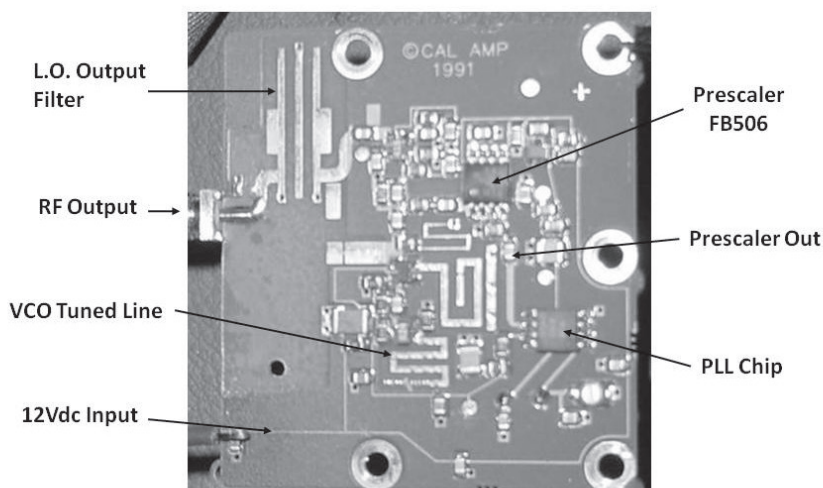


Photo B - Cal Amp LO and Output Filter

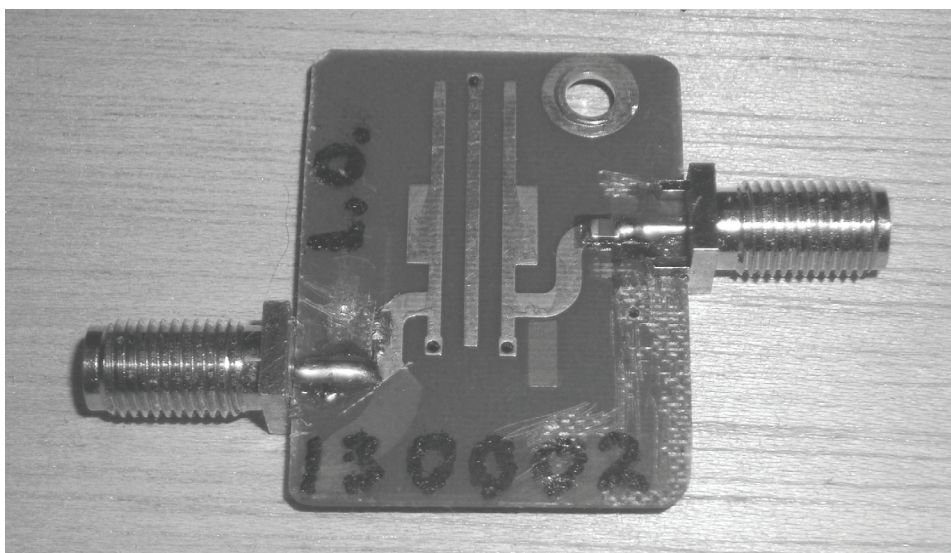


Photo C - Salvaged LO Bandpass Filter with SMA Connectors

in the end plates and the square tubing end faces. The end plates have clearance holes and the enclosure end face holes are threaded. After tapping the holes, I fastened everything together and trimmed the assembly on a disc sander. The result looks good, Photo D, and works. It was nice to be able to make the shielded enclosure in one try without having to remake any of the parts. I applied peel-n-stick labels and applied a protective coat of clear lacquer. The final result is shown in Photo E.

Summary

The result is a pre-tuned bandpass filter suitable for the 2.2 to 2.3 GHz satellite downlink band for a cost of \$1.50, not counting the two SMA connectors.

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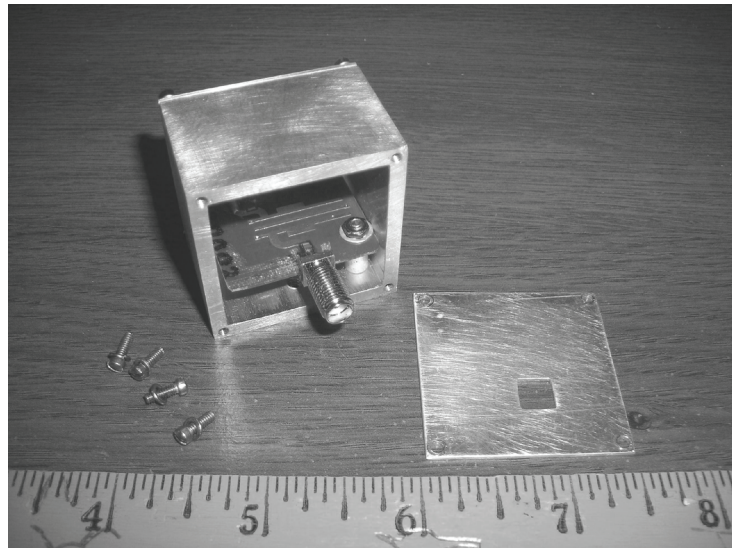


Photo D - Bandpass Filter with Homebrew Case Parts

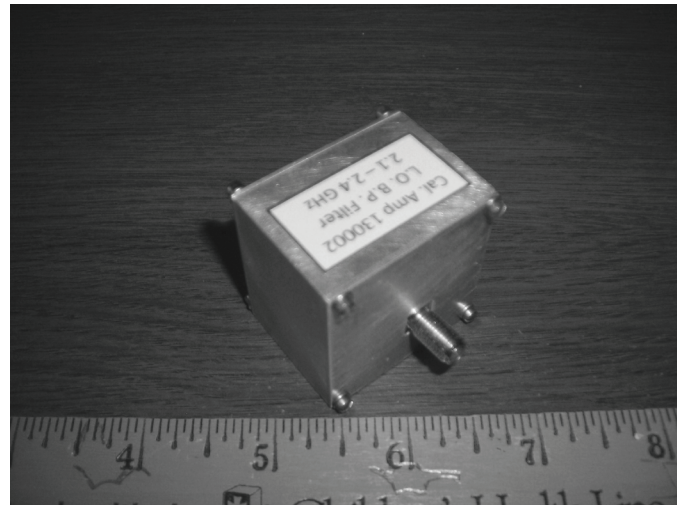


Photo E - Packaged Bandpass Filter



Photo from PhoneSat "Graham" assembled from packets sent by amateur radio stations. Additional pictures are posted at <http://www.phonesat.org/pictures.php>

A Soyuz-2-1b from the Baikonur launch facility, in Kazakhstan on April 19, 2013 launched four cubesat missions using amateur radio frequencies. CubeSats OSSI-1, SOMP, BEESat2/3 and AIST are operating in the amateur radio bands.

OSSI-1, the Open Source Satellite Initiative satellite is a cubesat developed by Hojun Song DS1SBO. In addition to the radio beacons OSSI-1 also carries a 44 watt LED optical beacon to flash Morse Code messages to observers on Earth.

The Student Oxygen Measurement Project (SOMP) is a cubesat developed by students of the Technische Universität Dresden, Germany, organized in the Students' Research Group for Spacecraft Engineering in Dresden (STARD). SOMP will be a standard sized single CubeSat with one payload side and five sides with two solar cells each.

BEESat-2 is a cubesat-sized vehicle which carries a technology experiment using gyros and sensors for precise orientation.

BEESat-3 is another cubesat-sized vehicle that will test high-speed data links (up to

1MB/s). The AIST cubesat mission will measure the Earth's geomagnetic field. No detailed frequency information is currently available other than it carries a 435 MHz downlink/145 MHz command & control uplink.

An April 21 Antares launch from Wallops Island, Virginia orbited three PhoneSat Cubesats. All three of the Phonesat cubesats carried an amateur radio payload on 437.425 MHz. Each cubesat transmits 1200 baud AFSK AX.25 packets during individual time slots. A photo was assembled from received packets sent in from amateur radio stations globally (see page 28). The first test flight of the Antares rocket was very low (270 km x 300 km, 51.6 deg) and these cubesats have now deorbited.

An April 25 CZ-2D rocket launch from China orbited the TURKSAT-3USAT Linear Transponder by TAMSAT and Argentina's CubeBug-1 satellites. Also aboard this launch Ecuador's NEE 01 Pegaso 1U cubesat which is not operational on amateur radio frequencies.

TURKSAT-3USAT is a three unit CubeSat developed to provide SSB/CW communications in a 680 km Low Earth

Orbit. It will fly a V/U linear transponder developed by TAMSAT, the Turkish Amateur Satellite Technologies Organisation.

CubeBug-1 is the first technology demonstration mission for a new CubeSat platform design (mechanics, hardware and software) intended to be released as Open Source and Open Hardware for its use in Amateur projects, University projects and research labs. After the technology demonstration part of the mission is over, the satellite will enter a mode that will include services to the Amateur radio community, including a Digipeater, science data downloads from the payload (including images if possible).

A May 7 launch of an ESA Vega rocket from the Kourou Spaceport orbited Estonia's first CubeSat ESTCube-1, with an amateur radio callsign ES5E/S. The cubesat was built by students at the University of Tartu. The main mission of the satellite is to test electric solar wind sail technology, a novel space propulsion technology that could revolutionize transportation within the solar system. It will deploy a 10 meter conductive electrodynamic tether and the force interacting with the tether will be measured. 

Satellite	Operating Mode(s)	Downlink (MHz)	Uplink (MHz)	Comments
OSSI-1	CW, 1k2	145.980 - CW 437.525 -1k2	-	Also carries 44W optical beacon
SOMP	CW, 1k2 and 9k6 BPSK, AX25 FSK, and AO40 standard 400bit/s BPSK	437.485	-	University research
BEESat 2/3	4800bps GMSK/ Mobitex	435.950	-	University research
AIST		435.xxx - telemetry data	145.xxx - command & control uplink	University research
TurkSat-3USAT	V/U Linear Transponder	435.200-435.250 (centered on 435.225) Output power 30 dBm 437.225 - CW beacon or 9600 bps data	145.940-145.990 (centered on 145.965) Receive sensitivity -120 dBm	Send reception reports of CW beacon to turksat3usat@tamsat.org.tr Do not use uplink until notified by control station
CubeBug-1	9k6 GMSK data	437.445	-	Plan to repurpose for amateur data when primary mission completes.
Phonesats	1200 bps AFSK AX.25 packet	437.425	-	Deorbited
ESTCube-1	CW beacon, 9600 bps AX.25 telemetry	437.250 - CW beacon 437.505 - 9600 bps	-	CW beacon, callsign ES5E/S AX.25 telemetry, callsign ES5E-11

NASA announced on May 13, 2013 that AMSAT's Fox-1 spacecraft has been assigned for launch in 2014 on the ELaNa XII mission. The expected orbit is 470 x 780 km at 64 degrees inclination. This orbit has a lifetime of about 11 years.

AMSAT Vice President Engineering, Tony Monteiro, AA2TX reported that the software development team successfully brought up the Fox-1 system software on the Internal Housekeeping Unit (IHU). The IHU is the brains of the Fox-1 satellite and it has a 32-bit, STM32L microprocessor. The operating IHU card was shown in the AMSAT Engineering booth at the Dayton Hamvention.

The Fox-1 Engineering Team will deliver the satellite for integration with the launch vehicle during May, 2014 with the launch scheduled for November, 2014. Tony commented, "While this is later than we had hoped, it is well within the normal variance of ELaNa launch dates and the extra time will be most welcome for additional satellite testing. This is very exciting news and really puts the focus on finishing the satellite and ground station software development."

President Barry Baines says, "AMSAT's focus on STEM education and development of a cubesat platform capable of flying a science mission with a reliable communications link resulted in the selection of Fox-1 in the third round and RadFxSat (Fox-1B) in the fourth round of NASA's Cubesat Launch Initiative."

Fox-1 and the Fox-1B RadFxSat missions are based on similar system architecture. Both satellites:

- Include a U/V (mode B) FM analog transponder. Its 2 meter down link should be even easier to hear than AO-51.
- Are designed so you can work it with just a dual-band HT and an "arrow" hand-held antenna.
- Will send telemetry on the voice downlink in the frequencies below the audible band as low-speed FSK with forward error correction.
- Will support a high speed digital data mode.
- A free telemetry decode program, FoxTLM, will be available to decode and display the low-speed telemetry and the high speed data

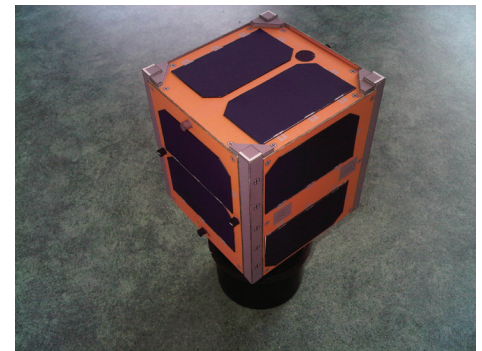
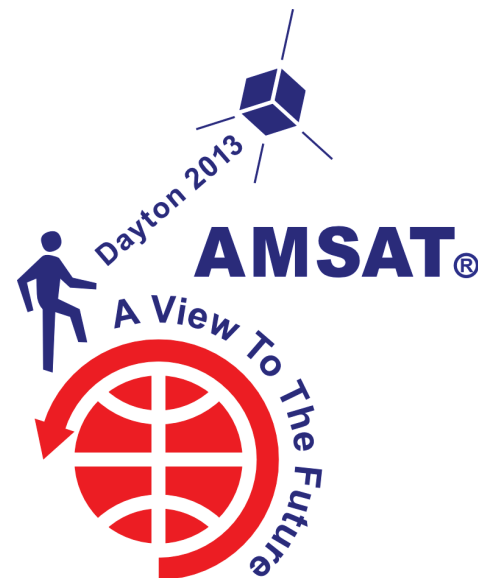
downlink on Fox-1. An updated version of the software will be provided for RadFxSat.

- All Fox cubesats are designed to host advanced science payloads to support future science missions that help us to continue qualify for NASA ELaNa (free) launches.

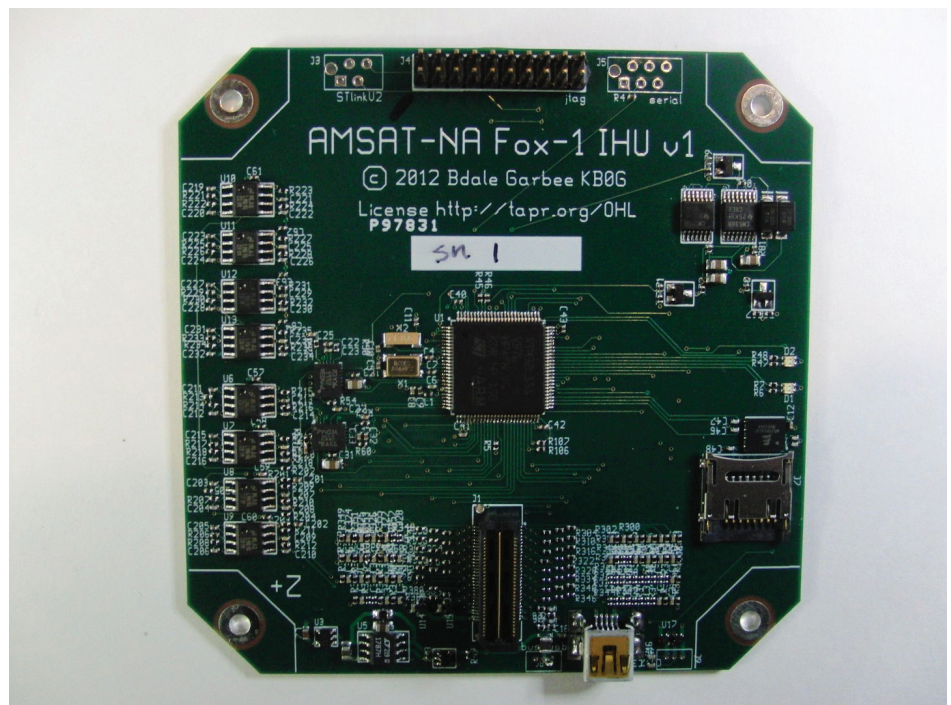
The Phase 1 *Fox* satellites are 1-Unit CubeSats. They each include an analog FM repeater that will allow simple ground stations using an HT and an "arrow" type antenna to make contacts using the satellite. This was the mode made so popular by AO-51. The Phase 1 CubeSats also have the capability of operating in a high-speed digital mode for data communications.

In addition, the Fox-1 satellite will include a space radiation experiment from Vanderbilt University and a JPEG Digital Camera from Virginia Tech. The Vanderbilt Low Energy Proton experiment will detect single-event upsets in memory devices and will operate all the time. The experiment data will be down-linked with the satellite telemetry. The camera will operate when the satellite is in the high-speed digital data mode and will take one photo each minute.

Watch the *AMSAT Journal*, the AMSAT web site (<http://www.amsat.org>) and the AMSAT News Service for more details to follow.



Stefan Wagener, VE4NSA, developed a new 1:1 scale cardboard model of the Fox-1 CubeSat printed in color on heavy stock paper. The kit is available for a suggested donation of \$25. All proceeds will go to supporting the Fox Project.



Serial #1 of the Fox-1 Internal Housekeeping Unit (IHU) now runs the satellite's system software.

AMSAT Shows Fox-1 at Dayton Hamvention



(right) AMSAT Vice President Engineering Tony Monteiro, AA2TX shows the Fox-1 Engineering Model at the AMSAT Booth during the 2013 Dayton Hamvention. (KB1SF photo.)



Fox-1 Internal Housekeeping Unit operational and on the air during the Hamvention. (KB1SF photo.)



Tony Monteiro, AA2TX with Fox-1 Engineering Team member Burns Fisher, W2BFJ in the AMSAT Engineering Booth at the Hamvention. Burns developed the Fox-1 software build environment and software tools chain with Bill Reed, NX5R. (KB1SF photo.)



The Fox-1 Digital Camera Module developed by a student team at Virginia Tech, led by Bob McGwier N4HY, was on display. (KB1SF photo.)



(L-to-R) AMSAT President Barry Baines, WD4ASW; ARRL Chief Executive Officer Dave Sumner, K1ZZ, and Tony Monteiro, AA2TX discuss the Fox-1 Project at the Hamvention. (KB1SF photo.)

Watch for coverage of all AMSAT activities at the Dayton Hamvention coming in the June/July issue of the *AMSAT Journal*.



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Fox apparel



Fox Golf Shirt

Fox Hat



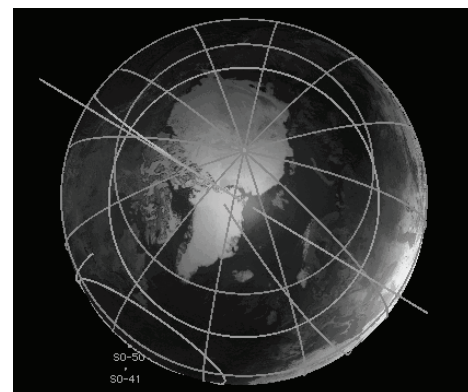
Fox Tee Shirt

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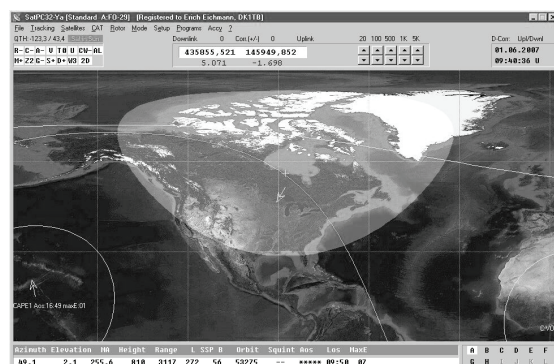


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